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THE

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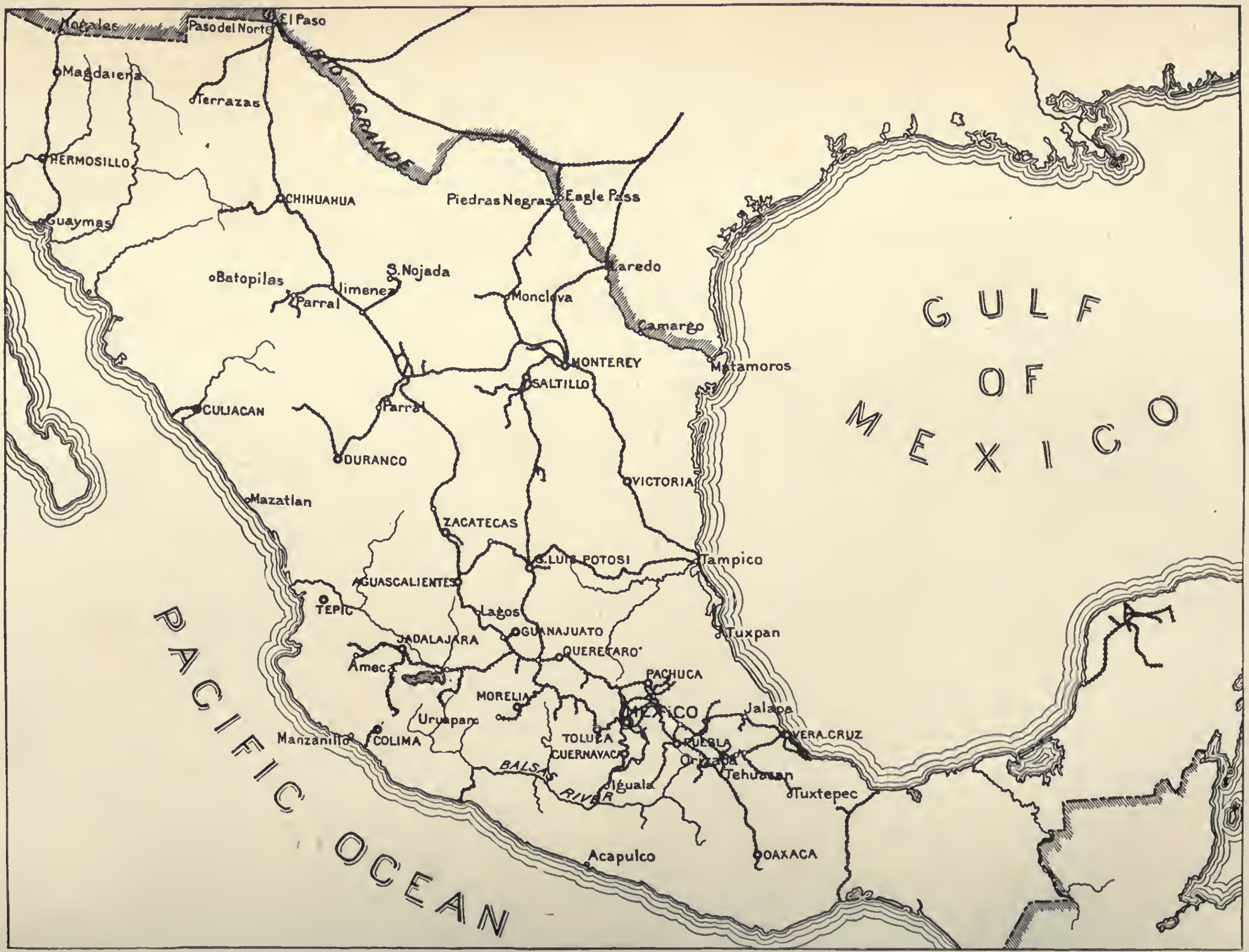

Map showing Railways of Mexico

VOL. XIII, NO. 1 WASHINGTON JANUARY, 1902

THE NATIONAL GEOGRAPHIC MAGAZINE

THE NEW MEXICO*

BY JOHN W. FOSTER, EX-SECRETARY OF STATE

WHEN I was invited by the National Geographic Society to deliver a lecture in its course on my observations during a recent visit to Mexico, I felt that it would be a work of superfluity on my part. The means of communication with our neighboring Republic are now so frequent and easy, and the intercourse between the two countries is so intimate, I doubted whether I could add to the stock of knowledge of the members of the Society, especially of a geographic character; but your President thought differently, and it may be of some interest to hear the observations of one who, having resided in Mexico for seven years, returns to it after a period of twenty years, and to listen to his narrative of the progress made in the interval, and of the present conditions of that country.

RAILROAD CONSTRUCTION

It may be first noted that the greatest change in the face of the country of a geographic character has been in the construction of an extensive system of railroads and the consequent improvement in the means of communication. The first thing which strikes a visitor today who knew Mexico a quarter of a century ago is the facility and comfort with which the journey to the City of Mexico is now made. When I began the preparation for my first journey, in 1873, I found that the only means of regular communication was by a steamer from New York, departing from that port every three weeks, and which occupied usually twelve or fourteen days in reaching Vera Cruz, stopping at a number of ports en route. From that port to the City of Mexico a railroad had been finished that year, which had been nineteen years in building, a distance of 264 miles. Today four lines of railroad enter the Mexican Republic from the United States, and one can make the journey in five days from Washington to the City of Mexico in a Pullman car on the regular trains, with only one change, either at Kansas City or New Orleans.

The era of extensive railroad construction did not begin till after General Diaz had been firmly seated in the presidency. With the aid of liberal subsidies, railroad building began in

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*An address before the National Geographic Society, January 3, 1902.

General Porfirio Diaz, President of the Republic earnest about 1880, the only road of any length at that time being the one just mentioned, from Vera Cruz to the City of Mexico. There are now completed and in operation 15,454 kilometers, approximately 10,000 miles, and by means of these lines the capital is connected with all the important cities of the country. Four lines enter the Republic from the United States. One branches off from the Southern Pacific in Arizona and traverses the State of Sonora to the port of Guaymas. The second, the Mexican Central, crosses the boundary line at El Paso, extends to the City of Mexico, with a branch line to Tampico, an important seaport on the Gulf of Mexico, and another branch to Guadalajara. The third, built under the auspices of the Southern Pacific system, from San Antonio, Texas, crossing the Rio Grande at Eagle Pass, intersects the Mexican Central at Torreon and extends some distance beyond the city of Durango, its ultimate goal being the Pacific coast; and the fourth international line, the Mexican National, crosses the boundary at Laredo and extends to the City of Mexico, being a narrow-gauge road. From the City of Mexico various other roads lead to important districts, and most of the main lines have a number of branches constructed to reach rich mineral and agricultural districts.

MOUNTAINS AND TABLE LAND

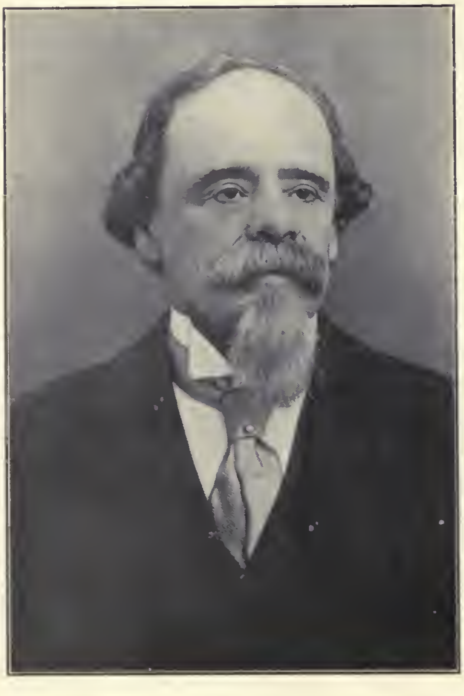
The configuration of the Republic lends itself to easy railroad connection with the United States. The great Andean Range, coming up from South America, is crowded in by the two oceans and depressed as it passes through the isthmus connecting the two continents, but as it emerges from the narrow neck of Tehuantepec into the wide expanse of North America, apparently glad of its escape from the ocean barriers, it again shoots up its peaks toward the sky, and branches off into two grand mountain chains, the one following the Pacific and the other the Gulf coast, and, like the brawny arms of a giant, lift Mexico up onto the vast tablelands which stretch far away into the United States.

The work of connecting the capital through this vast tableland with the United States was comparatively easy. But when it came to constructing the lines from the high elevation of the City of Mexico, as has been done in various directions, toward the coasts, it became a herculean task, calling for engineering skill and a large expenditure of capital. Notwithstanding the obstacles, the mountain range confronting the Gulf has already been pierced by at least four lines of railway, and they are now in operation to Tampico and Vera Cruz, the two most important ports on the Gulf. But thus far the Sierra Madre Range traversing the Pacific coast line has not been completely crossed. The Guadalajara branch of the Mexican Central Road has been extended some distance toward Manzanillo, and work on that extension is being pushed to completion.

The Mexico, Cuernavaca and Pacific Railway, a road under enterprising American management, leaving the City of Mexico, climbs to a height of 10,000 feet above the sea-level, then descends into the charming valley of Cuernavaca, cuts its way through the mountain gorges amidst most beautiful scenery, has already reached the Balsas River leading into the Pacific, and has a comparatively easy course along its valley to the Pacific port of Acapulco.

The Tehuantepec route across the Isthmus has for many years been a competitor in expectancy with that of Nicaragua and Panama for the world's commerce. The canal project gave way to the Eades ship-railway scheme, but an ordinary railroad was finally completed some years ago. It was, however, cheaply and imperfectly constructed, and was without suitable ports at its termini, and hence could offer no competition with the Panama Railroad. The road has now passed into the hands of an experienced and responsible English company, which will entirely rebuild the road, and the federal government has made contracts with it for the construction of good ports of capacity for the largest vessels, in which work the government will expend several millions of dollars. When these improvements are completed it is claimed this route will be able to successfully compete with the Panama Railroad for much of the Isthmus traffic.

The construction of lines of telegraph have not only kept pace with the railroad extension, but far exceeded it, and there are now in operation 42,500 miles. In addition to this the telephone system is established in all the principal cities and towns and with their adjacent villages.



Hon. Ignacio Mariscal, Secretary of Foreign Relations

PUBLIC PEACE AND ORDER

The establishment of railroad communication and the ramification of the telegraph throughout the length and breadth of the country have not only brought new life and activity to the commerce and industries, but they have had a most salutary effect upon public order. Before this new epoch it was very possible not only for bandits and outlaws to maintain themselves in the mountain fastnesses and remote regions, but for revolutions to be hatched and grow into formidable proportions, owing to the inability of the government to concentrate troops. Now every part of the Republic is within easy reach of the federal authority.

Hence, the old-time visitor to Mexico on his return today is struck with the everywhere-prevailing evidence of peace and security to persons and property. Books of travel on Mexico written twenty-five years and more ago are full of hair-breadth escapes from brigands, assaults upon the stage coaches, kidnapping of the rich for ransom, and the depredations of robbers and revolutionists. The passenger trains between the City of Mexico and Vera Cruz each carried a car full of soldiers as an armed guard, and even with that precaution the male passengers usually wore side arms, and a guard of soldiers was kept at every station. No man of business or of importance ventured on journeys outside of the cities, large towns, or haciendas (plantation-houses surrounded by a high stone wall) without a number of friends heavily armed or a regular escort. Today trains run daily in almost every state of the Republic without any guards, assaults upon the stage coaches have long ago ceased, kidnapping is a thing of the past, robberies on the highways are almost unknown, travelers armed with pistols, rifles, and swords

Hon. José Y. Limantour, Secretary of Finance

(a common practice in the past) are rarely seen, and only in the remote and mountainous districts. The use of large bodies of soldiers to preserve peace and order has been supplanted by individual gens d'armes or policemen. Besides the visitor's own observations of security and peace, the old residents of Mexico will tell him that in this respect the country has undergone a complete transformation.

I think it may be safely asserted that life and property are as fully protected in Mexico as in the United States. It would be idle to say that murder, robbery, and disorder do not occur in Mexico, for that would be to assert that the passions of man have changed; but it is perfectly correct to say that today outlawry is of rare occurrence, and that in few countries of the world is better protection afforded to persons and property. In the past twenty years the telegraph lines have more than tripled in extent and in number of offices, and now at midnight there comes up to the national palace in the City of Mexico, from every near and remote town in the Republic, the message, "No hay novedad." It is like the cry of the mediæval night watchman, "All's well," that assured the citizen of peace and security.

The primary cause of this state of civil order has been the maintenance of a government of peace and of a continuous régime. Much had been done under Juarez to remove the causes of the revolutions, and under Lerdo a considerable advance had been made in civil government; but since the advent of General Porfirio Diaz to power, in 1876, there has been no foreign war and no serious disturbance of an internal character, the only exception being the outbreak of certain semi-independent Indian tribes. In the previous fifty years of the existence of the Republic, there had been as many presidents, the majority of whom owed their existence to revolutionary movements. The wretched story of Mexican history of that period is too familiar to be repeated here.

OTHER LATIN-AMERICAN REPUBLICS

The blessings which the era of peace and order attending the administration of President Diaz has brought to the country and the significance of the achievement will be better understood by a very brief reference to the other Latin-American states of the hemisphere during this same period. Every one of the five states of Central America has suffered from revolutionary movements and violent changes of government, and at times they have engaged in war with each other. Colombia has been torn by political dissensions, and is even now undergoing the ravages of revolutionary movements. Ecuador has been the scene of many revolutions and the displacement of one president by another through armed force. Peru has suffered by a foreign war, whereby the most valuable of its territories were torn away, and one revolution has followed another in quick succession, with changes of rulers. Chile, once the most conservative and prosperous of the South American countries, has carried on an expensive foreign war, has undergone a bloody and exhaustive revolution, and, because of its hostile attitude to its neighbors, has been compelled to maintain a large army and costly navy. Bolivia, shut out from the sea by a jealous neighbor, has been in frequent turmoil and political disorder. The Argentine Republic, though greatly favored by nature and by progressive rulers, has not been free from revolutionary movements, and has undergone a serious financial disaster, which has greatly paralyzed its industries. Brazil, by a conspiracy in the army, expelled the emperor and established a republic; but that did not bring it peace, for the new government has had to contend with successive attempts at revolution. The history of Venezuela in the past twenty-five years has been one of repeated revolutions and changes of government.

From this hasty sketch of the other nations of the American hemisphere to the south, in contrast with Mexico, the brilliancy and the beneficence of the administration of President Diaz is made apparent. In a recent inaugural address to Congress, on again being installed as President, he referred to the achievements of Mexico in the past twenty-five years, and modestly stated that in it there were no brilliant deeds to chronicle. From that notable address I make this extract:

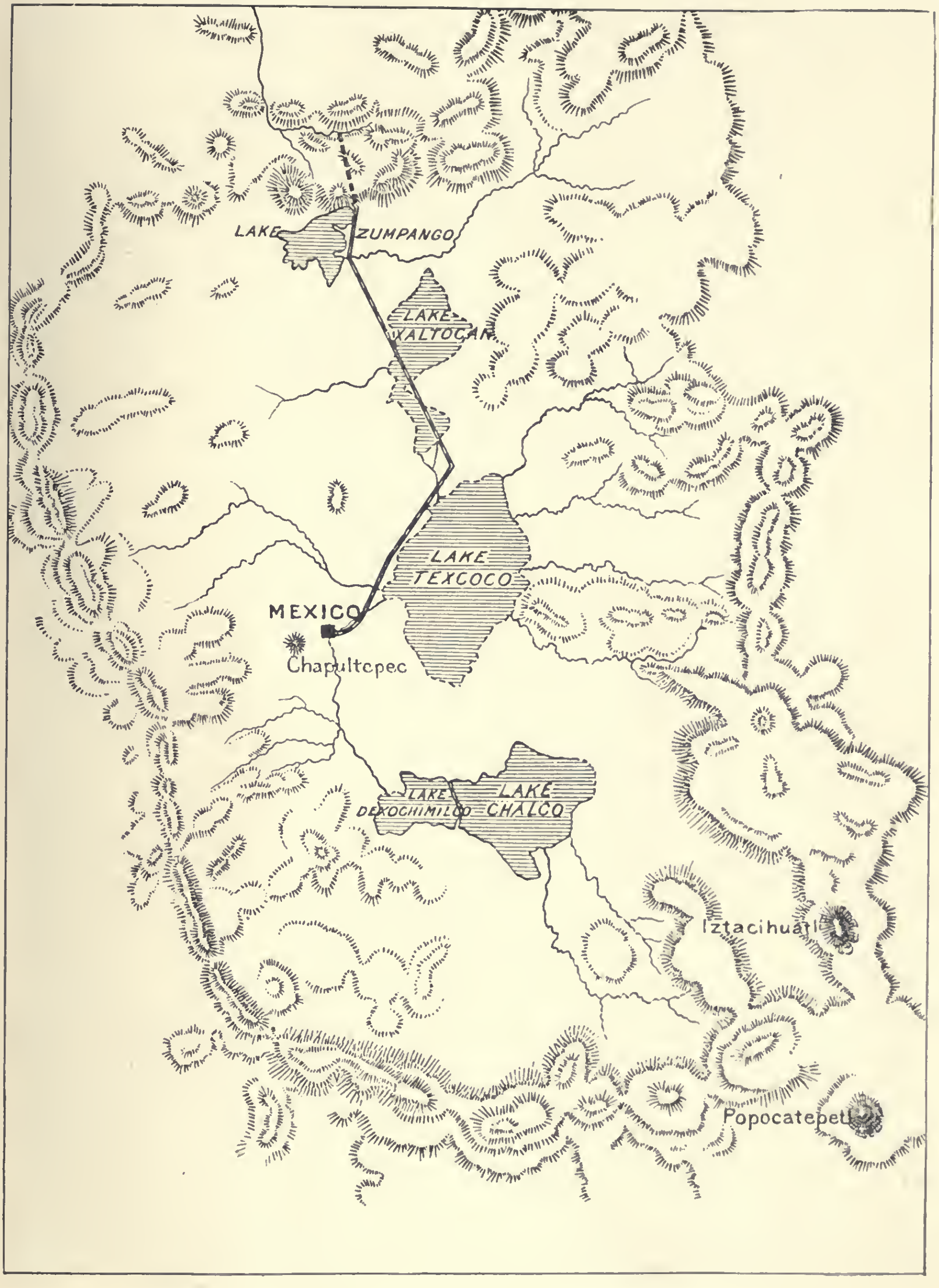
"If it were true that a peaceful and laborious people have no history, the administrative period I am about to review would almost be devoid of history. But, on the contrary, those nations that deserve to be called happy in the only intelligible sense of the word, far from being without a history, have a very glorious and interesting one, if besides being peaceful and laborious they are also progressive.

"That history is the history of their progress, their achievements, their growing prosperity, of the improvements of every kind which they have introduced—a history which, in this modern age and the present constitution of civilized societies, is as interesting as that of their past and just as deserving of attention."

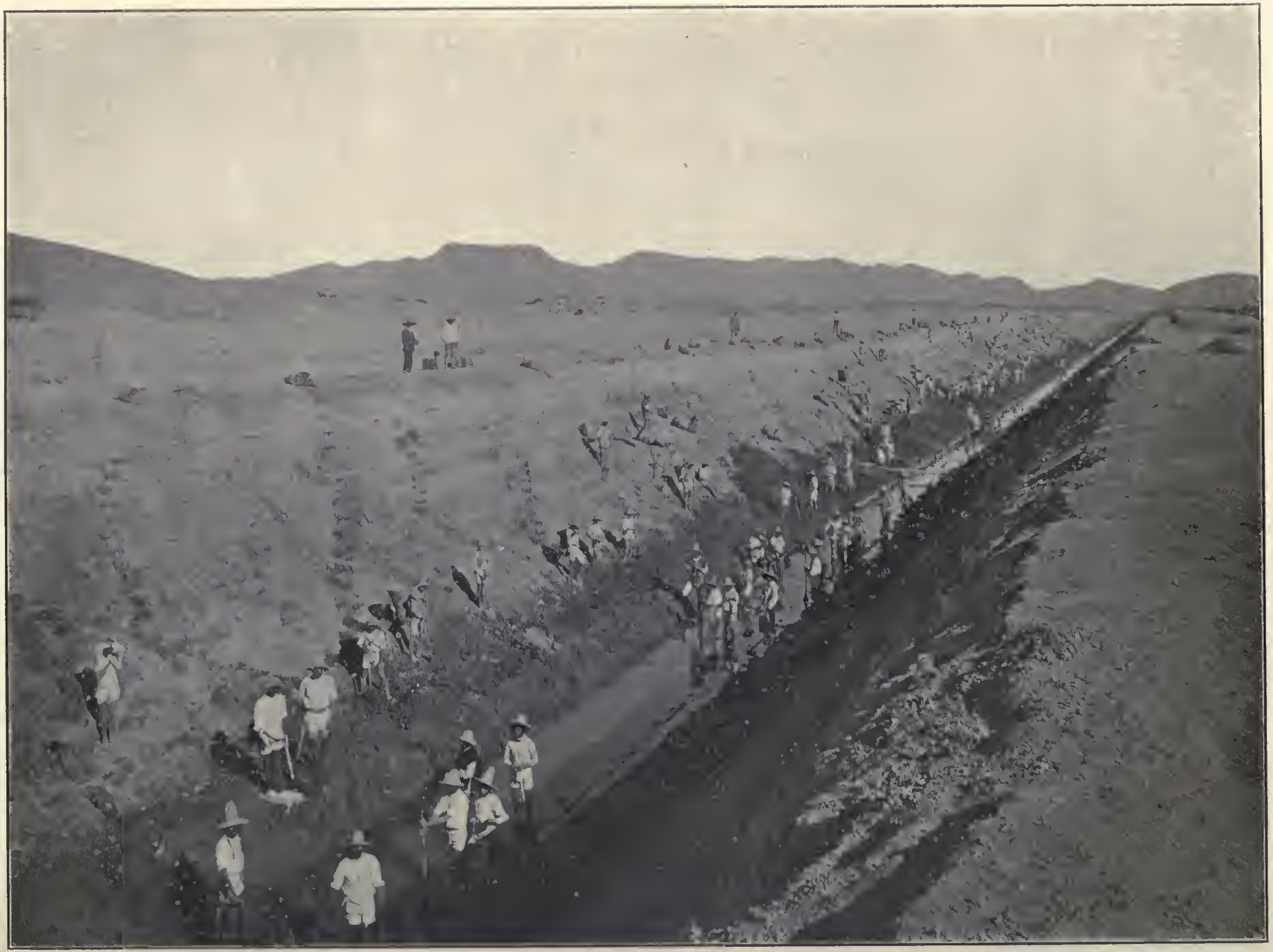
DRAINAGE OF THE VALLEY OF MEXICO

Next in importance of a geographic character to the vast railway system, which has done so much to transform the face of the country and the habits of the people, is the great drainage canal of the Valley of Mexico and its adjunct improvements. As is well known, the City of Mexico is situated in the bottom of a valley entirely surrounded by mountains, with a series of lakes on the southeast and northwest, draining into a salt-water lake which has no outlet, on the shores of which this most ancient city of America was located. Owing to its location, the capital was constantly exposed to overflows, and from time to time it has been visited by most destructive inundations. Besides, on account of the necessarily imperfect sewage system, the death rate of the city has always been very high.

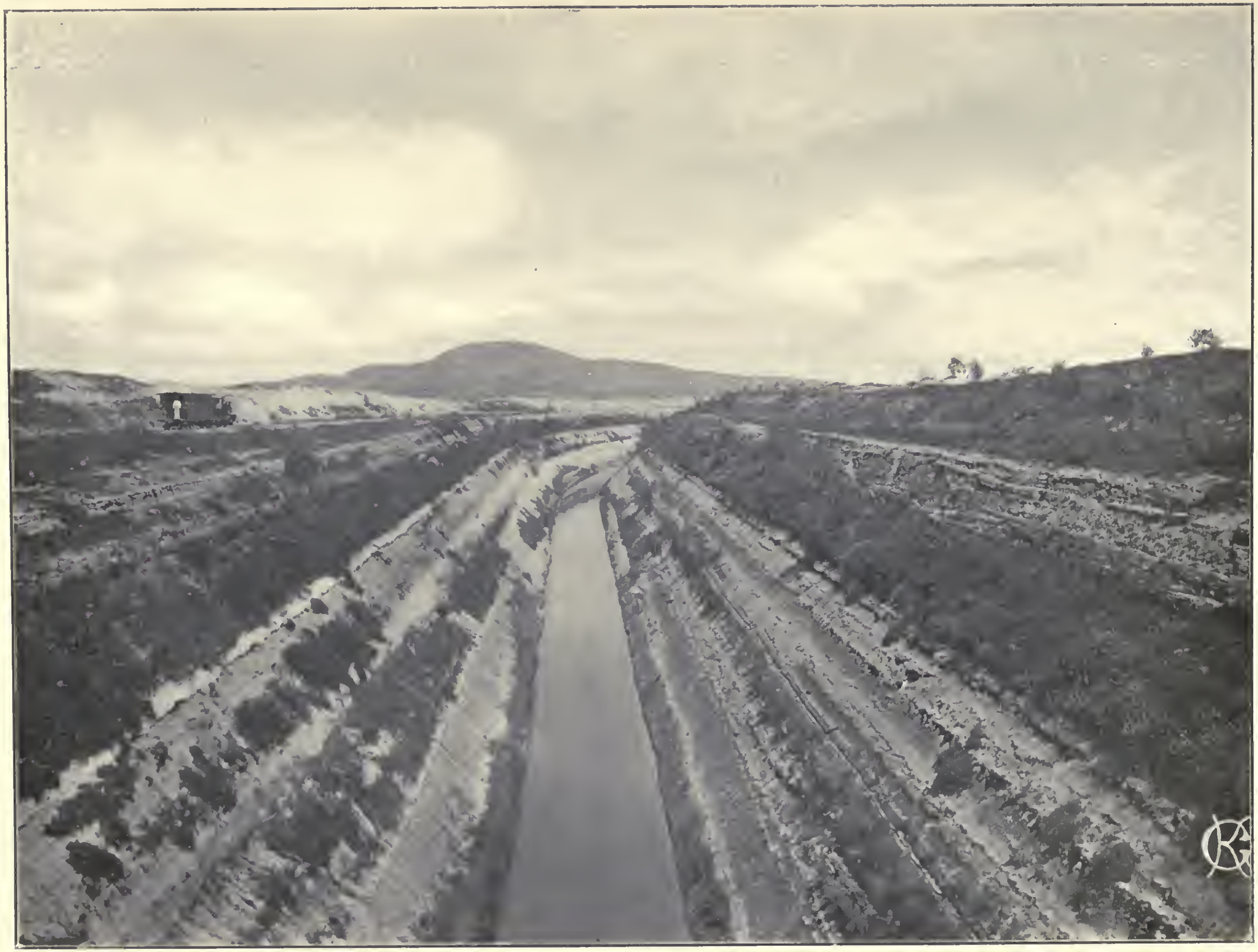
For six hundred years, from the time of the ancient Aztec kings, the artificial drainage of the waters of the valley has been the vexed problem of each succeeding government. The Spanish viceroys exhausted the engineering science of their epochs, spent hundreds of millions



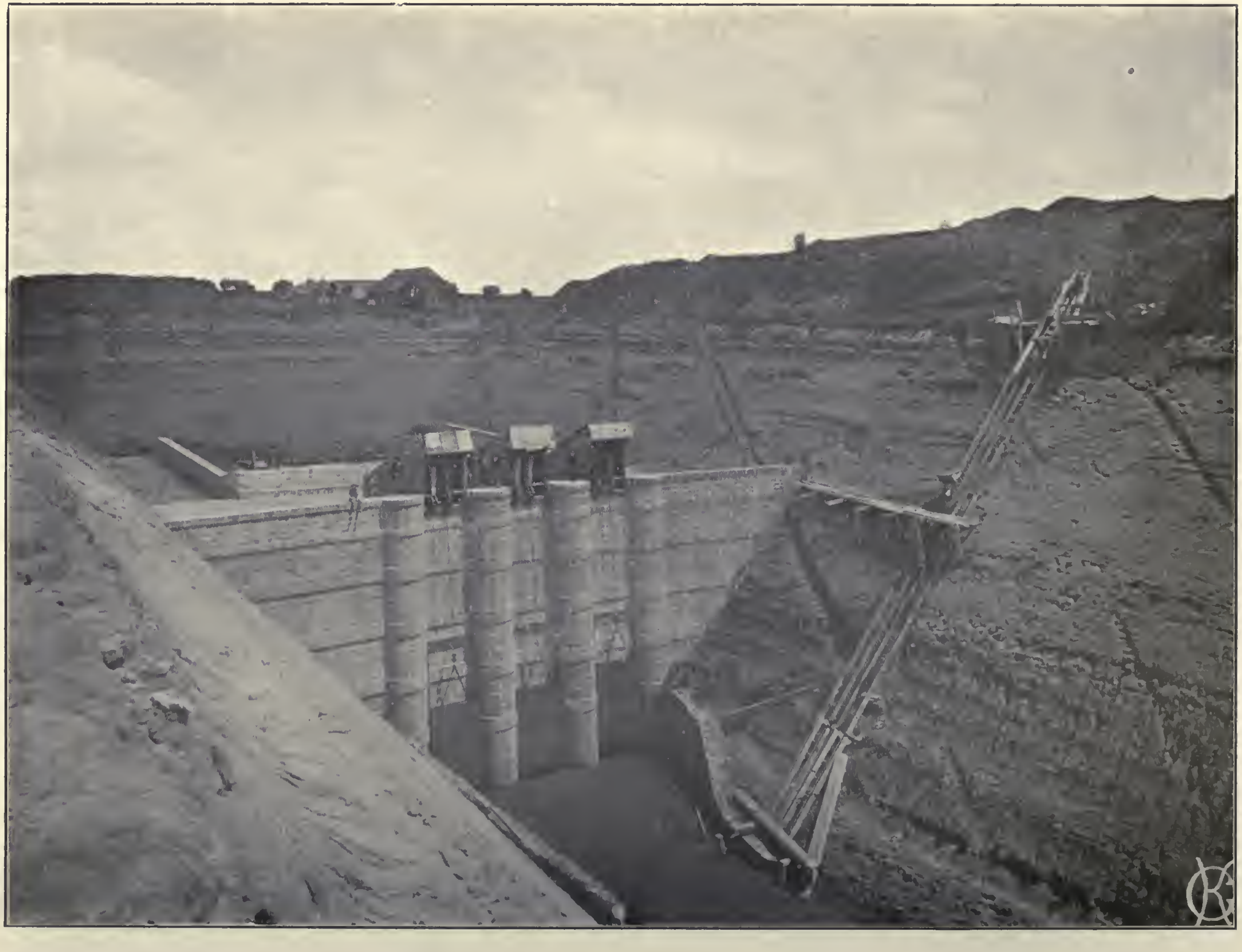
Map showing Area Drained by the Great Canal



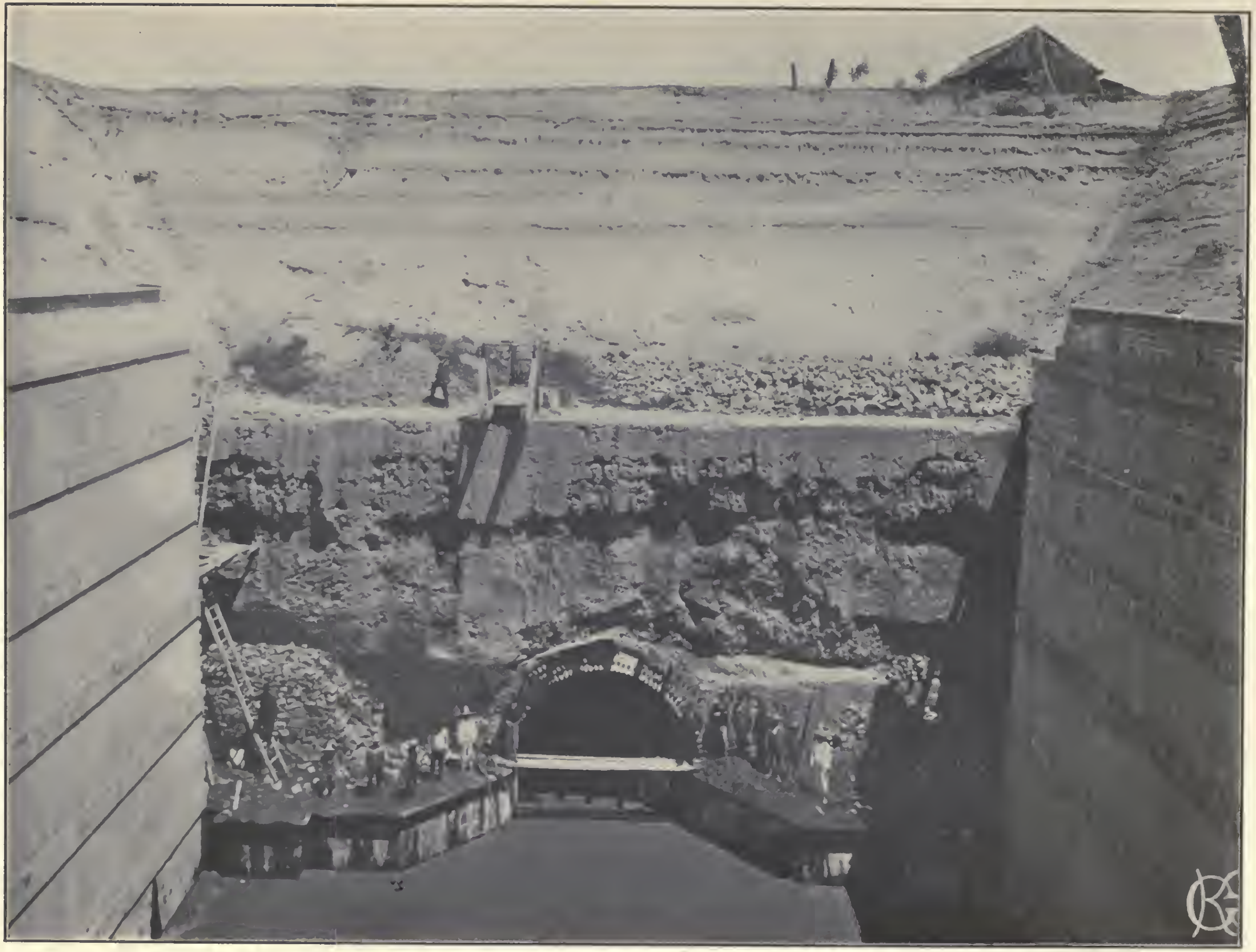
The Drainage Canal, under Construction



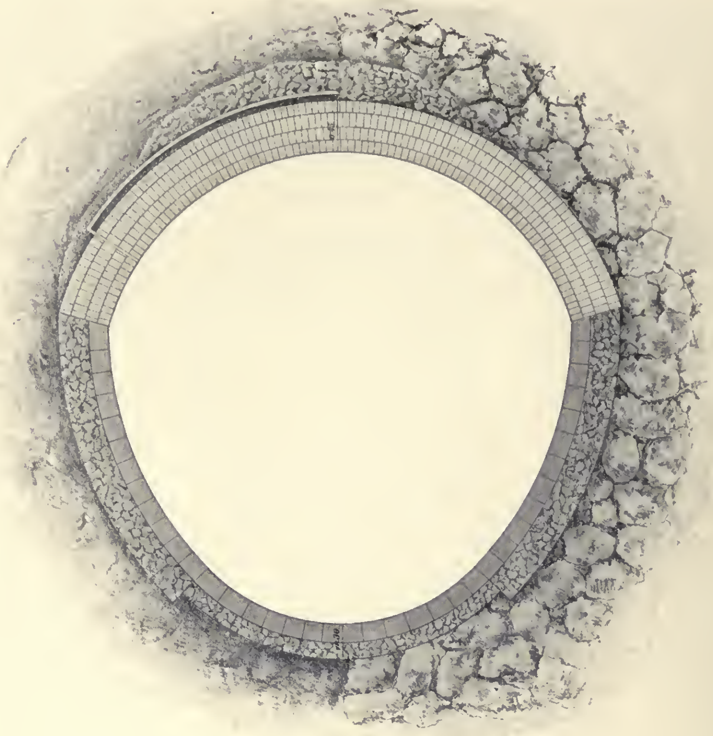
The Drainage Canal, Completed



The Drainage Canal Water Gate



The Mouth of the Drainage Canal Tunnel



Cross-section of the Tunnel

Width, 4.180 meters ; Height, 4.286 meters

of dollars, and sacrificed the lives of hundreds of thousands of the natives in the vain attempt to solve it. During the first half century of the Republic spasmodic and feeble attempts were made to effect the drainage, but succeeding revolutions or foreign wars deprived the government of the financial means to accomplish the herculean task. It was reserved for President Diaz to achieve success in this great enterprise. He was forced to delay the beginning of the work for some years until the financial condition of the public treasury would justify it and until he was enabled to secure contracts with experienced engineers and trustworthy capitalists. Finally, for the last time, the project was entered upon and was successfully completed two years ago. The system consists of a tunnel six miles long, extending through the mountains, and with it is connected a canal, the total length of the waterway being nearly thirty-seven miles. It cost $20,000,000, including the drainage of the city, and may justly be said to take rank with the great achievements of modern engineering.

The city is now safe from overflow, and the last step in this great work is in process of completion—the connection with the canal and tunnel of a new and perfect system of drainage for the capital. For some time past the streets have been torn up in laying the drainage pipes, but this work is now practically finished, and the municipality, with the aid of $2,000,000 from the federal treasury, is engaged in the task of relaying the streets with asphalt pavement. When this is completed the City of Mexico will be one of the cleanest, healthiest, and prettiest cities in the word.

THE CITY OF MEXICO

Humboldt, in his visit to America at the beginning of the last century, pronounced it the best-built city on this hemisphere. During the rule of Spanish viceroys, under the stimulating influences of the great riches yielded by the mines of Mexico, the capital contained a population much greater than that of any other city of the new world, and it numbered among its public buildings a cathedral unequaled in size and architectural attractions, the result of a hundred years of labor and pious contributions; institutions of learning and beneficence, public gardens and drives without rivals in any other of the western countries. But during the first fifty years of the independence of the country, torn by civil dissensions, the capital remained stationary, or at times even retrograded, while New York and Philadelphia, as well as Rio de Janeiro and Buenos Ayres, outstripped it in the race for population and development. All that was needed, however, to enable City of Mexico again to take its place the among the first cities of the hemisphere was the preservation of public order. With the establishment by General Diaz of a government of peace and security, beginning at the close of 1876, the capital gave the first symptoms of returning prosperity. When it became apparent that the new chief of the state had the power to preserve a continuous government of law, and the executive ability to awaken the dormant resources of the country, under the new régime of peace which had at last dawned upon the country, the City of Mexico entered upon an era of prosperity unparalleled in its history. Population began to flow in from the surrounding states; native wealth, which had been hidden away or deposited in Europe, returned to the natural channels of trade, and foreign capital, which during the time of disorder had kept away, began to seek methods of investment. Before the first term of Diaz came to a close, the construction of railroads had been entered upon under government aid.

Today the capital of the Republic presents to the old-time resident the most impressive evidence of the growth and prosperity of the country. During the Diaz administration it has nearly doubled in population, the census of 1900 showing over four hundred thousand souls. The area of the city has greatly extended, especially in the suburbs to the west and northwest. Formerly it was regarded as unsafe for a well-to-do family to live outside of the city gates. As soon as the new government could give an assurance of safety to life and property, the movement of suburban enlargement began, and now the most beautiful and commodious private residences are found in the quarter named, far away from the noise and bustle of the center of the city. In all parts the price of real estate and of rents has largely advanced, especially to the west of the national palace, and marvelous stories are told of the enormous increase in value in suburban real estate—many hundreds per cent; and it is gratifying to be informed that wide-awake Americans have shared in the profits, the projectors of "La Colonia Americana," laid out by a New Jersey corporation, being among the most successful promoters.

IMPROVEMENTS OF THE CAPITAL

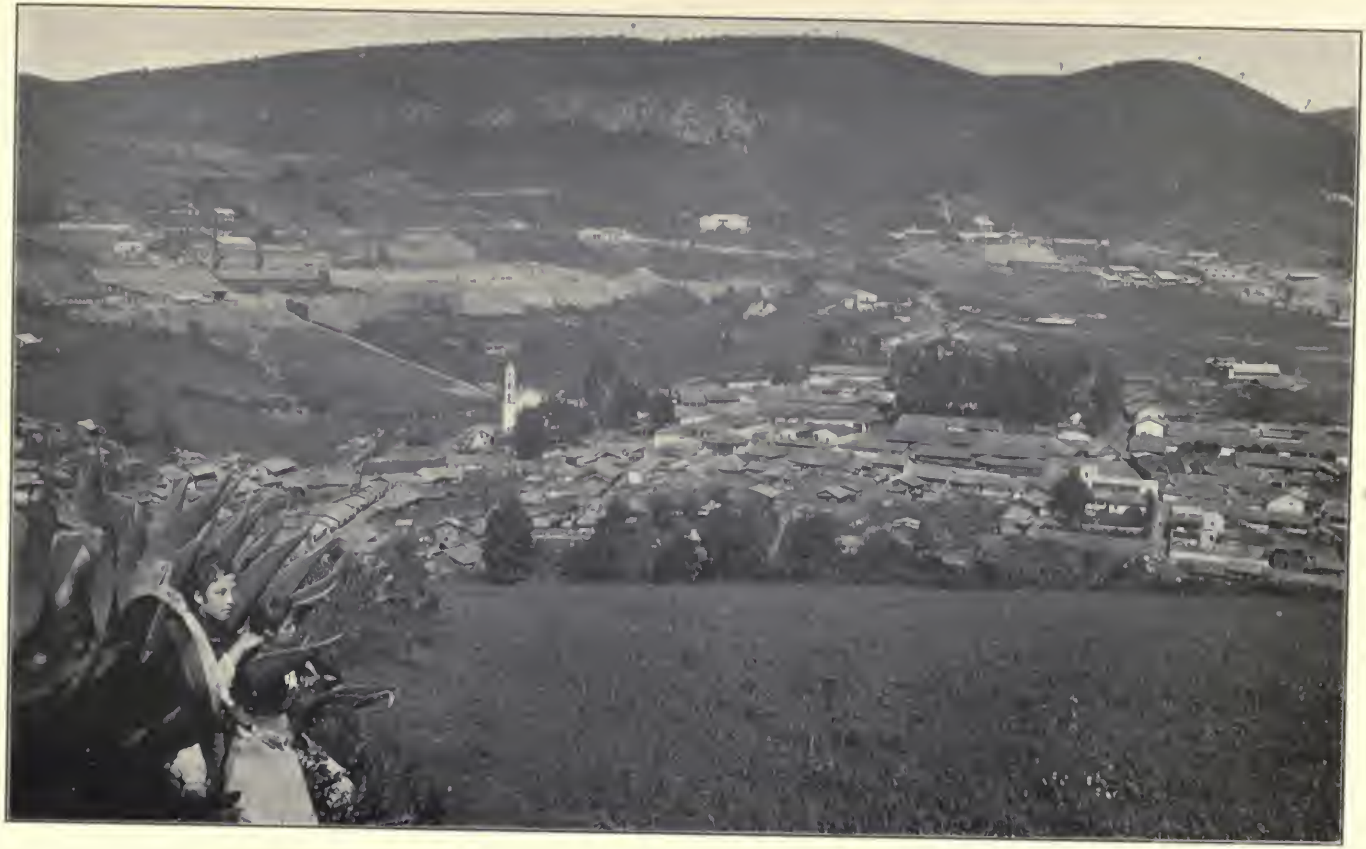
The evidences of progress and prosperity are to be seen on every hand. The streets are much more crowded than formerly, the foreigners are more numerous, and among these Americans predominate. The shops are enlarged and multiplied in number. In the central part of the city substantial houses have been torn down to give place to magnificent business edifices constructed of steel and marble, with electric elevators and all modern appliances of a first-class establishment in New York or Paris. The government has taken the lead in this era of reconstruction. A new and extensive general hospital, one of the largest and best equipped in the world, and a new penitentiary, as perfect as the advance in humane study could make it, have just been completed. The foundations of a Hall of Congress, which promises to be an imposing edifice, are being laid, and the appropriations have been made for a new department post-office and other public buildings which will greatly beautify the city. The many friends in the United States of the late Matias Romero, so long the honored minister of his country in Washington, will be glad to learn that the great advance in real estate largely enhanced his modest property in the capital. In his will he stated that he owed all he possessed to his country, and he devised the great body of his estate to the founding of a home for indigent old people, which will constitute one of the improvements of the city.

The ancient system of street railways is undergoing a great transformation. It has passed into the hands of a foreign syndicate, which is supplanting the old method of mule traction with electricity, and is replacing the old-fashioned and rickety cars with those of improved modern construction. In fact, the Diaz epoch may be called the régime of electricity, as in his day it has been introduced very generally into the houses and streets, not only in the capital, but in all the principal towns of the country.

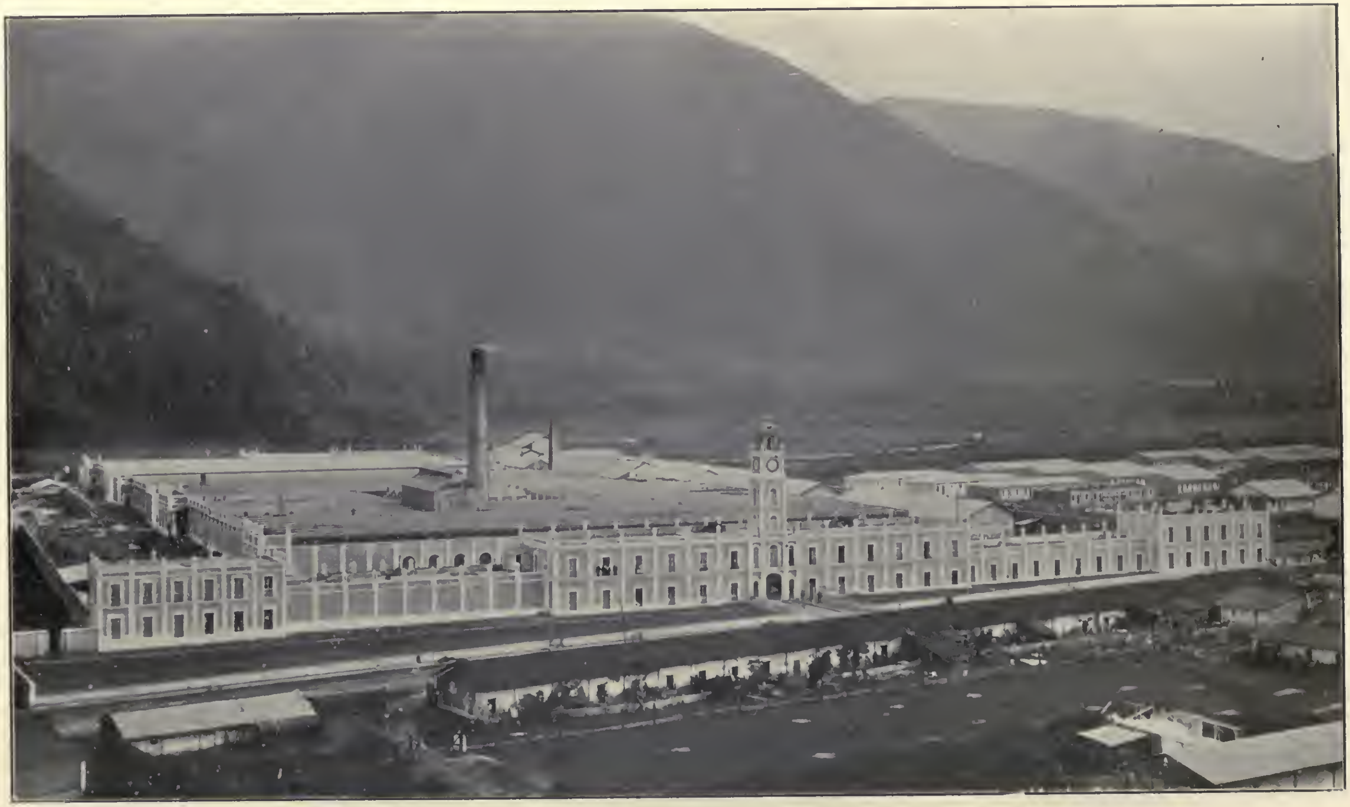
One of the chief attractions of modern Mexico is the fashionable driveway, the Paseo de la Reforma. It has been greatly widened, ornamented at frequent intervals with statues of public men and artistic figures, and extended to the Castle of Chapultepec, lying nearly a league away from the center of the city. At the foot of this picturesque castle there has been laid out a beautiful park, which is being constantly enlarged and adorned, and which will soon rival the most famous pleasure grounds of the world. The old visitor to Mexico will, however, have to mourn the loss of many of his dear friends, the so-called "Montezuma trees," the grand old cypresses, some of the most colossal of those surrounding the castle having died. In its present setting of green and flowers, with paved roads and objects of art, the old castle of the Montezumas and the Spanish viceroys appears more lovely than ever. The view from its summit, embracing a wide area of the broad valley, everywhere covered with verdure, the waters of the lakes sparkling in the sunlight, the capital, with its towers and wide-spreading edifices, the many villages nestling among the semi-tropical vegetation, the amphitheater of high mountains surrounding and shutting in the valley, with the lofty volcanoes, clothed with eternal snow, standing as hoary sentinels of the scene—all this constitutes a vision, in my judgment, unsurpassed in any other part of the world. In this day of prosperity and improvement, no wonder the Mexican is proud of his capital and his country.

IMPROVEMENT OF THE SEAPORTS

Another geographic phase worthy of notice is the transformation which has taken place in several of the seaports of the country. It is related that a King of Spain, on a visit to Cadiz, was seen with a glass scanning the horizon across the waters to the west. A court-



Mining Camp at El Oro



Cotton Factory at Orizaba

ier asked him what was the object of his search, and he replied that he and his ancestors had spent such vast treasures on the fortress at Vera Cruz he thought he ought to be able to see some of the towers of the castle rising out of the sea! The story illustrates the marked difference in the Spanish rule in Mexico and that which prevails today. The object of Spain was to keep off intruders and preserve the commerce of Mexico as a monopoly for the mother country. The policy of the present régime is to invite to its shores all the commerce of the world and afford free access to its ports.

The country has heretofore labored under a serious embarrassment in the accomplishment of this purpose, in that on the Atlantic or Gulf coast it had no harbor worthy of the name. Vera Cruz, the principal port, was nothing but an open roadstead. But during the administration of Diaz a thorough system of improvements has been entered upon and is now approaching completion. In shutting off the northern passage by a sea-wall, connecting the island upon which stands the famous Spanish castle with the mainland, a comparatively safe harbor is afforded to vessels, and the landing and customs facilities are being greatly increased. In these improvements the federal government is spending several millions of dollars. Tampico possessed an excellent harbor, but it was rendered almost useless by a bar which cut off access to all but vessels of very light draught ; but under contract with the government a system of jetties similar to that at the mouth of the Mississippi has been successfully constructed, and a channel of 23 feet has been secured across the bar. As a result of this improvement and of the construction of a railroad connecting the port with the capital and with the important city of Monterey, Tampico is aspiring to rival Vera Cruz in its foreign commerce.

The ports of the Pacific coast possess natural advantages and adaptability to shipping not found on the Gulf coast, but some of these also are undergoing important improvements, and when the railroads projected and now in course of construction across the Sierra Madre Range reach them, they will doubtless participate more fully in the great industrial and commercial development of the country.

GROWTH OF FOREIGN COMMERCE

In view of this development, it would naturally be anticipated that foreign commerce would feel the effects of the general prosperity, and the statistics fully sustain this expectation. In 1875, the year previous to the accession of President Diaz, the total imports amounted to less than $19,000,000, and during the fiscal year of 1899 the imports had increased to $106,000,000 in silver. The same gratifying condition has attended the export commerce. In 1875 the exports were $27,000,000, and during the last fiscal year they amounted to $150,000,000, thus showing the enormous increase of 500 and 600 per cent. In the order of their importance the leading articles imported were as follows: Machinery, cotton textiles, iron and steel, wines and liquors, wool textiles, paper, and crude cotton.

It is gratifying to note that the United States leads all other countries in the amount of this import trade, having about one-half of the total, Great Britain coming next with 20 per cent, France and Germany with 10 per cent each, leaving 10 per cent divided among Spain, Belgium, and other countries. The leading classes of imports from the United States are given in the order of their importance: Coal, wood and lumber, cotton, steel rails, mineral oil, vegetable oils, carriages (railroad, etc.), cotton cloths, electrical apparatus, wearing apparel, hardware, sewing machines, furniture, agricultural implements, boots and shoes.

Although there has been this greatly

enlarged import commerce, it is by no means as large as it should be, taking into consideration the fact that the country possesses nearly fourteen millions of people. There has been cause in the past for the comparatively small import trade in the disordered condition of the country, the poverty of its inhabitants, and the habit of the mass of the people of subsisting on the bare necessities of life. The enlarged commerce under the Diaz régime illustrates the effect of peace and prosperity in enabling the inhabitants to consume more largely of comforts and luxuries from abroad. If this era of peace and good government shall become the fixed order of the country, there is no reason why the present import trade may not be doubled within a few years, and if American merchants and manufacturers will study more intimately the conditions of trade in Mexico, they will be able not merely to maintain their present preëminence, but even to increase their ratio.

Examining the details of the export trade, we find that the United States is extending to Mexico liberal reciprocity; for, while we enjoy only about 50 per cent of her import trade, she finds in our country a market for about 75 per cent of all the products she sends abroad. Great Britain follows with 10 per cent, France with 4 per cent, and Cuba leads Germany in the consumption of Mexican products. If we also consider the mining and agricultural conditions of the country, we shall see that it possesses almost boundless capacity for the increase of its export trade, if the present state of order and government shall continue. The leading products now exported are, in the order of their importance, as follows: Silver, henequin or sisal hemp, gold, coffee, cattle, lead, copper, hides, and precious woods.

The facilities for conducting the foreign commerce have been greatly multiplied. When I first visited the country, as I have mentioned, the only regular means of communication with the United States was by a steamer to and from New York, sailing once in three weeks. Today steamers sail for that port from Vera Cruz and Tampico twice a week, a new line has been recently established to New Orleans, lines of steamers are plying regularly from the two Mexican ports mentioned to England, France, Germany, and Spain, with many irregular steamers to various parts of the world. Then only one railroad reached the seacoast, and that only from the capital. Now four more lines are in operation, connecting the seaports with almost all the states of the interior. Then there was no railroad communication with the United States. Today four different lines enter Mexico from her northern neighbor. Of the total import and export trade about two-thirds in tonnage is carried by ocean vessels and one-third by the railroads.

The subject of a reciprocity treaty between the two republics has been often mooted, and it is believed that a judiciously framed convention of this character would largely increase the trade between the two countries. But since the unseemly treatment accorded to the Grant-Romero reciprocity treaty of 1883 by the Congress of the United States, it is presumed that Mexico will be slow to make any new advance on the subject. And from the treatment which is now being extended by the same body to various treaties negotiated under President McKinley's direction with different foreign powers, I apprehend the Government of the United States will be slow to propose such a measure to Mexico.

GOVERNMENT FINANCES

The most conspicuous evidence of the good effects of the management of affairs by President Diaz is seen in the financial condition of the country, both official and private. When he assumed control, the financial condition could hardly have been more desperate. The revenues of the government since the re-establishment of the Republic had almost constantly shown a deficit. The public creditors, domestic and foreign, were unsatisfied. For many years the interest on the foreign debt had been defaulted; its bonds had no value at home or abroad, and were not quoted in the money markets of a single city of the world. There were a few private banks in the capital, but no banking system existed in the Republic. As a consequence, and because of the risks of communication, exchange between the different cities of the country was very high, standing at 5 to 8 and sometimes 10 per cent. Although the revenues barely reached $20,000,000 annually, it was very difficult to collect the taxes on account of the sluggish condition of commerce and industries.

The rigid enforcement of peace and security by General Diaz soon began to bear fruit in a marked improvement in financial affairs. The government early felt its effects in, first, a gradual, and finally, a rapid increase in its revenues. I do not propose to confound my hearers with long tables of figures which are the usual accompaniments of the discussion of financial and commercial questions. It will be sufficient to state that the revenues, which before had been barely $20,000,000 annually, soon doubled, then trebled, and within ten years had increased more than sixfold, reaching as high as $140,000,000.

This marvelous increase had its natural effect upon the policy of the government. First, it enabled it to extend its aid toward greatly needed public improvements. It not only granted concessions to an extensive system of railroads, but it also contracted to pay the different companies liberal subsidies, without which it would have been impossible for most of them to be built. It also entered upon an expensive system of harbor improvements at Vera Cruz, Tampico, and other ports in encouragement of commerce. It made the long-needed drainage of the Valley of Mexico a success. Every department of administration felt its wholesome effects—the post-office and telegaph service, government buildings, the schools, the army, and the navy.

REDUCTION OF TAXATION

This increase in the revenue also enabled the government to take another important step, to wit, the adoption of a complete revision of the system of taxation. Heretofore it had been the practice of the government to rely upon the import and export duties for the greater portion of its revenues. A new tariff was adopted which, while it preserved the protective system, was much less burdensome to foreign commerce, and abolished almost all the export duties on Mexican products shipped abroad. A system of internal taxation was adopted which made the levies much more equal in their effects, but the general result was a large reduction in taxation.

This era of financial prosperity put it into the power of the President to remove a grievous burden upon commerce which had long been the dream of progressive Mexican rulers, the abolition of the "alcabalas," a system of taxation whereby duties were collected on products and merchandise passing from one state to another. It had been declared abolished by the liberal constitution of 1857, but the poverty of the state treasuries had heretofore made it impossible of realization. The abounding prosperity of the Diaz régime had extended to all the states, and in 1896 the "alcabalas" ceased to exist; and with them has disappeared another mediæval revenue annoyance, the "octroi" taxes, collected at the city gates on all articles of consumption entering the city, a system still in force in many of the countries of Europe.

The reduction made in the various branches of taxation has largely diminished the receipts of the national treasury, having brought them down to about $60,000,000 annually, but this sum proves more than sufficient for all the current needs of the public service, as at the end of each fiscal year a considerable balance remains subject to appropriation for special purposes.

This financial revival brought upon the administrative departments multiplied work and new problems to solve, and President Diaz sorely felt the need of a man of business capacity, of thorough uprightness of character and industry for the portfolio of Secretary of Finance, and he was most fortunate in his ultimate choice. Jose Yves Limantour is a gentleman of culture and inherited wealth, to which he has largely added by his skillful business management. He had no taste for political life, and when the call came to him to accept this post he was reluctant to do so, and only yielded from a high sense of patriotic duty. To him greatly is the President indebted for the splendid success which has attended the reorganization of the taxation methods just mentioned, for the establishment of a well-ordered banking system, and for the rehabilitation of the foreign credit and the public debt.

THE PUBLIC DEBT

This latter work has been most successfully carried out. From the earliest days of independence the public foreign debt has been a fruitful source of embarrassment and shame for the Mexicans. In 1825 loans were effected in London for £20,000,000, and only a few years elapsed before the recurring revolutions forced default in interest, and for years this debt remained nominally of no value. In 1851 the creditors had to accept a refunding, with loss of accrued interest and reduction of the rate, but this proved only a temporary expedient. New foreign debts to English, French, and Spanish capitalists were added, only to be soon defaulted or repudiated. This latter action brought on the tripartite intervention of 1861 which led to the Maximilian Empire. The situation was most deplorable when Diaz came into power, but the financial improvement which he inaugurated soon began to create confidence among European capitalists, and the rapidly growing revenues finally enabled the Secretary of Finance to re-establish the government credit abroad. By the year 1888 he had succeeded in consolidating all the discredited foreign indebtedness of every character whose legitimacy could be established and issuing therefor new gold bonds bearing 6 per cent interest, and from that date the treasury has not failed to pay the interest promptly. This action, with the continued improvement of the finances, placed these bonds at a premium of 102½ in London, and advances were made to the government by leading foreign bankers to convert the foreign gold-bearing debt into a new loan at 5 per cent interest, and this transaction was consummated last year, the bonds being taken by three reputable banking houses of Berlin, London, and New York. The entire foreign indebtedness of Mexico is therefore now represented by a single 5 per cent gold loan, with coupons payable in the three cities just named, amounting to $115,178,000.

This was accepted as a great triumph for the government, and justly so when we recall the depth of utter bankruptcy from which the country has been reclaimed. Its credit is now equal to that of some of the first powers of Europe and much above that of any other of the Latin-American republics. If we take the three South American countries which have been the most prosperous and have always commanded the highest credit in London and compare them with Mexico, taking recent quotations of their foreign loans of the same date, we have this result :

	London quotations.
Argentine Republic 6 per cent loan..	93
Brazil 4 per cent loan...............	62
Chile 5 per cent loan................	92
Mexico 5 per cent loan.......	99

In addition to its foreign loan, Mexico has what is termed an interior debt, payable in silver, amounting to a sum which if converted into gold would represent approximately $62,000,000, created by subsidies to railroads, obligations for public improvements, etc. Thus the entire indebtedness of the republic amounts to about $177,178,000. It may be profitable to make a further comparison. This debt is borne by a population of 13,570,000. Canada, her more northerly neighbor, has a debt of $345,160,000, with a population of only 4,833,000 souls. In other words, Mexico's indebtedness is $13 per inhabitant, while that of Canada is $71 per inhabitant.

In connection with government finances, it may be well to call attention to the fact that Mexico is upon a silver basis, and that all business transactions are conducted upon that basis. The prevailing opinion is that it is very advantageous to the country; but there are some of its most intelligent people who contend that the system is injurious, and that at no very distant period Mexico will adopt the gold standard. But no such change is considered by the government or by the ruling financial interests.

THE FOREIGN RELATIONS

It will not be possible in this paper to discuss at any length the political questions which arise in connection with the present state of Mexico, but I must make a brief reference to its relations with foreign countries. When President Diaz assumed the reins of government the evil effects of Maximilian's attempt to establish an empire on the ruins of the republic were yet being felt. The country had not recovered from the exhausted condition into which its resources had been brought by the long, bloody and expensive war. The passions of the contending parties, which had been so deeply embittered by that terrible contest, had not altogether calmed down ; and the foreign nations which had taken part in or sympathized with the intervention—France, Great Britain, Austria, and the other European powers—had not renewed their relations with the restored republican government.

It was important for the well-being of the country that the wastes of war should be restored, that the people should bury their partisan rancor, and especially that the two first-named nations should renew their diplomatic intercourse, because from them would come much of the capital and skill to develop the country's great resources. Time and statesmanship were requisite for this task. One of the first acts of General Diaz toward the accomplishment of these ends, after he became well seated in power and when the step could not be interpreted as a sign of weakness, was to call into his counsel two of the most prominent and able men in the government of his predecessor, President Lerdo, whom he had driven from power—Manuel Romero Rubio and Ignacio Mariscal—the former the head of the Lerdo cabinet, and the latter for so many years the accomplished Mexican Minister in Washington. The fact of the acceptance by these two men of office under the Diaz government was evidence of the consolidation of all parties and all interests in working for the future peace and prosperity of the Republic.

For twenty years Mr. Mariscal has served at the head of the cabinet as secretary for foreign relations, except when absent for a time as minister at London, and to his skillful and prudent management are in great measure due the satisfactory relations which Mexico has established with the other nations of the world. France and Great Britain soon overcame their scruples growing out of the death of Maximilian and the circumstances attending the intervention and reëstablished diplomatic relations. Their action was soon followed by all the other leading nations of Europe, except Austria, and even that monarchy has recently renewed diplomatic intercourse, and has buried any feelings of bitterness for an act which, under the circumstances, was for Mexico a political necessity, and would have been committed by any other civilized nation under similar provocation.

Mexico has also cultivated more intimate and friendly relations with the other Latin-American republics, and at no time has her intercourse with them been more pleasant than at present. By her larger population, by her worthy example of a quarter of a century of unbroken peace and constitutional government, and by the consequent era of unexampled development and prosperity, Mexico stands today at the head of the Latin-American states, and when it was suggested that the time was ripe for the holding of another Pan-American international congress similar to that which assembled in Washington eleven years ago under the direction of Mr. Blaine, it was unanimously agreed that the Mexican government was the proper one to issue the invitations, and that its beautiful capital was the ideal place in which the representatives of all the Americas should assemble. Whatever may be the outcome of the international congress now in session in the City of Mexico, I am sure every one of its delegates will leave that country with a higher estimate of its government, its people, and its resources.

MANUFACTURES AND MINING

This paper is already so extended that a number of topics of importance can be only alluded to very briefly. The protective system prevails in Mexico, the tariff on imports being regulated both with a view to securing revenue and to stimulate and protect domestic industries. Under this system manufactures have shared largely in the general prosperity of the country and have very greatly increased in production and variety, the chief attention being given to the manufacture of cotton fabrics.

Mining has for three centuries been the leading industry of Mexico, its output of silver usually standing first in the world's production of that metal. The new order of affairs has imparted fresh vigor to this industry, and a large amount of American capital has been invested in mining. The United States tariff on lead-bearing silver ores has also led to the establishment of large smelting works in various localities, a comparatively new industry in the country. In recent years the number of mines has greatly increased, the output of silver reaching near $70,000,000 annually, or over one-third of the total production of the world. Gold mining has had new development and is steadily increasing in its yield. Copper exists in various parts of the Republic, and the prevailing high price of late years has stimulated its production. The great want of the country in the mining industry is an abundant supply of good coal. Deposits have been found in the Rio Grande region, but the supply as yet is entirely inadequate to the needs of the country, as fuel for locomotives, mining, and domestic uses is still high and scarce.

AGRICULTURAL RESOURCES

Agriculture stands next to mining as

an industry, its total valuation being considerably greater, but its export value being less than the precious metals. Farming on a large scale has been quite profitable, the price of corn, the chief article of food of the masses, being usually twice as high as in the United States, as it is protected by a heavy duty. The production of sugar, on large plantations, is also a profitable industry, but the yield is barely sufficient for the home consumption; and although possessing a large area of sugar-producing lands, the country has as yet never been an exporter to any considerable extent. The most promising agricultural industry for development is coffee culture, there being vast areas well adapted for it, and its exportation has considerably increased of late years. Many of these lands have recently passed into the hands of American companies and citizens, and quite an impetus has been given to these enterprises, as well as others for the development of rubber. But most of these enterprises are still in the incipient stage, their permanent profit not yet having been fully demonstrated.

EDUCATION AND SOCIAL ADVANCEMENT

Did time permit much might be said of the social advancement of the people under the Diaz regime. In the past twenty-five years special attention has been given by the Government to educational matters, particularly to the public primary schools, which are now maintained in every political district. Their influence and the general prosperity are beginning to be felt in the elevation and intelligence of the masses. Newspapers are more widely circulated and read. Twenty-five years ago the circulation of the most widely read newspaper scarcely reached 15,000 copies, and that was regarded as phenomenal. Newspapers today issue fifty to sixty thousand copies, and they are read largely by the common people. The wages of mechanics in the capital and along the lines of railway have increased fifty per cent, and the working classes live in greater comfort.

As illustrative of the quickened moral standard of the people, a strong temperance movement has been organized in the City of Mexico and has extended to the other important cities. During my recent stay in the country, it was being visited by one of the officers of the Woman's Temperance Christian Union of the United States, and though it was quite unusual in that land for a woman to appear on the platform, this lady in her crusade against intemperance was received with enthusiasm, gratuitous use of the largest theaters was tendered her, she was introduced by the governors of states, and given free access to the public schools.

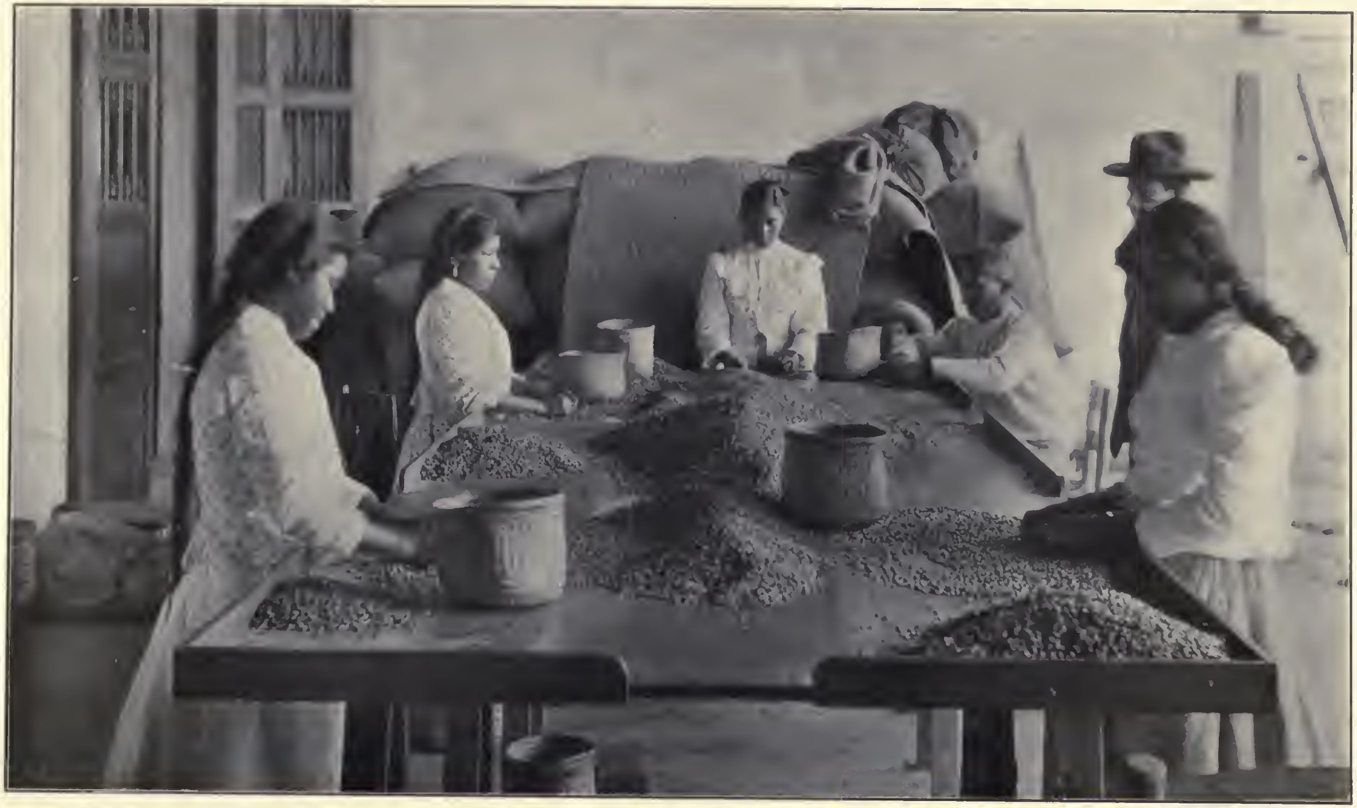
For a generation past Mexico has occupied the most advanced position of any of the Latin-American states respecting religious toleration, absolute freedom of worship being guaranteed by the constitution and enforced by the government. The mass of the people are devout Catholics, but the present archbishop is a man of liberal views, and he has done much to reconcile the people to the new order which Juarez established after the long and bloody war against the clerical party. The Protestant movement at first evoked opposition and violent outbreaks, but all that has passed, and its propagandism is peacefully tolerated in all parts of the land. Compared with the Catholic Church, its adherents as yet are few in numbers, but it has exerted a marked influence on that church. The morals and education of its clergy have been raised. The necessity of more preaching is recognized, pews are being introduced, the churches are cleaner and less gaudy in their interior, and the political utility of some religious division among the people is seen.

AMERICANS IN MEXICO

I must not close this paper without a reference to the Americans in Mexico. From the beginning of the Republic our countrymen, owing to the proximity of its territory, have made investments in that country and embarked upon various enterprises; but not until the reign of peace and order was assured by President Diaz did they go there in large numbers. They now constitute the largest foreign element in that country. The American colony in the City of Mexico is not only numerous, but prosperous and well established. It sustains a well-equipped club, an excellent hospital, and has all the paraphernalia of a well-ordered society intent on getting the most out of life, such as golf links, base-ball, women's clubs, afternoon teas, literary circles, etc. Americans have superintended the construction and are now directing the operation of some of the leading railroads. They have invested largely in mining, and colonies of American miners, numbering several hundred each, are to be found in different states. They have purchased large tracts of land for the development of coffee, rubber, and other agricultural products. Millions of dollars of bonds of the federal, state, and city governments have been sold in the United States in the past ten years. Many stock companies have been organized in various cities of the Union to develop and carry on enterprises in Mexico. Where the object and location of these companies have been judiciously chosen, and they are under experienced and prudent management, they are likely to prove successful, but money can be squandered in Mexico as readily as in other countries.

As a rule, the American residents in that country have found adequate protection for their persons and business. Occasionally complaint is made to our Government or through the newspapers of injustice on the part of the courts or authorities, but when investigated the complaint is generally found to originate either in a want of knowledge of the system of jurisprudence in force in that country (the civil law) or from an undue bumptiousness on the part of the American. Our citizens who voluntarily go to Mexico should bear in mind that they are in a community of a different race, language, religion, customs, and system of judicial procedure from ours, and if they adapt themselves to these changes they are quite unlikely to encounter embarrassment or trouble. Our countrymen, our capital and enterprise, are welcomed by the government and the people, and there is a wide field for the exercise of our surplus capital and energy.

Our political relations with the neighboring republic were never more cordial than they are today, and there is every prospect that the two nations will continue to enjoy together the blessings of peace, prosperity, and independence.



Coffee Pickers

COMMERCE OF MEXICO AND THE UNITED STATES

By Hon. O. P. Austin,
Chief of Bureau of Statistics, Treasury Department

COMMERCE between the United States and Mexico has made very rapid gains since the establishment of rail communications between the two countries. Prior to that time European countries enjoyed a large share of the import trade of Mexico, the exports from France and the United Kingdom ranging from five to ten million dollars per annum each, and those from Spain averaging about one million dollars annually, and those of Germany less than a million dollars. With the construction of railways giving close communication between Mexico and the United States, shipments from the United States into Mexico rapidly increased and quickly outgrew those from European countries.

In 1890 exports from the United States to Mexico were a little above thirteen million dollars, those from the United Kingdom and France each about ten millions, Germany three and a half millions, and Spain nearly two millions. As the railway lines from the United States extended farther into Mexico and the number of lines multiplied, the exports from the United States to that country grew to fifteen million dollars in 1895, twenty-three millions in 1897, twenty-five millions in 1899, thirty-four millions in 1900, and thirty-six millions in 1901.

Meantime the exports from the United Kingdom to Mexico, which were $9,794,000 in 1890, fell to $8,056,000 in 1895, and have in the last two years shown a slight reaction, being in 1900 $10,506,000. From France the exports, which in 1890 were $10,777,000, fell to $7,498,000 in 1895 and $7,060,133 in 1899. From Germany the exports to Mexico were in 1890 $3,544,000 and in 1899 $5,372,000; from Spain in 1890, $1,797,000 and in 1899 $1,891,000.

Thus it will be seen that the United States has, since the creation of a satisfactory railway system connecting this country with Mexico, made much more rapid gains in her trade with that country than any of the other parts of the world from which Mexico formerly obtained a large share of her imports. Exports from the United States to Mexico in 1900 were two and a half times as much as in 1890, while those from the United Kingdom show an increase of about 50 per cent, those from France a considerable decrease, those from Germany an increase of about 50 per cent, and those from Spain show little change. The United States now supplies considerably more than one-half of the imports of Mexico, and takes about one-third of her exports of merchandise, not including in this term her exports of precious metals, which nearly equal in value those of merchandise.

The principal imports into the United States from Mexico are sisal grass, used as a substitute for hemp in the manufacture of ropes, twine, etc.; coffee, copper, lead, hides and skins, and cattle. The imports of sisal grass in 1900 amounted to over eleven million dollars in value, having grown from a little more than four million dollars in 1891. Coffee imports into the United States from Mexico amounted in 1900 to a little over three million dollars; copper, including ore, three and a half millions;

lead, two and a half millions; hides and skins, one and a half millions, and cattle less than one million dollars in value.

On the export side, manufactures of iron and steel are by far the largest item in our trade with Mexico. Steam-engines increased from less than a half million dollars in 1891 to more than one million in 1900; machinery, from less than a million dollars in 1891 to more than five and one-half millions in 1900, and other manufactures of iron and steel, from two and a half millions in 1891 to more than seven millions in 1900. Coal and coke increased from a little more than a half million dollars in 1891 to about two and a half millions in 1900; lumber, from less than a million dollars in 1891 to nearly two millions in 1900; vegetable oils, from less than a hundred thousand dollars in 1891 to a million dollars in 1900; and chemicals, drugs, medicines, etc., from less than four hundred thousand dollars in 1891 to more than eight hundred thousand dollars in 1900.

The table which follows shows the commerce of the United States, United Kingdom, France, Germany, and Spain with Mexico from 1881 down to the latest available date:

Years.	UNITED STATES.		UNITED KINGDOM.		FRANCE.		GERMANY.		SPAIN.	
	Imports into, from Mexico.	Exports from, to Mexico.*	Imports into, from Mexico.	Exports from, to Mexico.	Imports into, from Mexico.	Exports from, to Mexico.	Imports into, from Mexico.	Exports from, to Mexico.	Imports into, from Mexico.	Exports from, to Mexico.
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*
1881..	8,317,802	11,171,238	2,878,218	8,202,247	1,590,883	8,998,140	361,998	699,006	228,146	871,861
1882..	8,461,899	15,482,582	2,818,531	9,526,252	1,797,737	10,119,841	309,400	823,004	240,4[illegible]6	1,077,079
1883..	8,177,123	16,587,620	3,546,485	7,884,956	1,537,337	9,791,092	497,420	823,718	211,929	1,231,029
1884..	9,016,486	12,704,292	3,408,984	5,271,164	1,011,578	6,574,365	872,984	878,696	160,423	891,811
1885..	9,267,021	8,340,784	3,527,468	4,217,654	1,198,445	5,987,782	1,791,188	644,742	114,066	931,112
1886..	10,687,972	7,737,623	2,877,497	4,883,252	1,025,098	7,583,221	1,788,332	986,510	192,253	1,043,810
1887..	14,719,840	7,959,557	2,306,833	5,751,488	1,540,063	7,631,701	1,310,190	1,146,208	180,386	1,266,468
1888..	17,329,889	9,897,772	2,215,070	6,683,432	1,655,085	8,471,374	1,750,728	1,616,020	50,788	1,344,885
1889..	21,253,601	11,486,896	2,267,760	7,889,112	1,655,389	10,777,561	2,569,686	3,463,424	159,526	1,625,364
1890..	22,690,915	13,285,287	2,642,407	9,794,133	1,326,657	10,681,834	2,608,718	3,543,820	84,975	1,797,487
1891..	27,295,992	14,969,620	2,401,389	9,522,023	1,659,540	8,809,652	3,046,400	3,374,840	200,007	1,509,521
1892..	28,107,525	14,293,999	2,209,732	7,099,372	1,903,072	6,837,205	3,554,054	2,960,720	112,150	1,433,075
1893..	33,555,099	19,568,634	2,843,182	6,115,623	3,340,453	5,386,822	3,000,446	2,934,540	166,949	1,250,786
1894..	28,727,006	12,842,149	2,699,671	6,446,477	3,046,585	5,822,073	3,068,058	2,689,876	193,402	1,345,545
1895..	15,635,788	15,005,906	2,274,266	8,056,622	2,265,482	7,498,579	2,844,100	4,040,288	336,793	1,476,952
1896..	17,456,177	19,450,256	2,885,846	8,187,658	3,029,884	6,390,245	3,338,618	3,687,096	307,315	1,675,657
1897..	18,511,572	23,421,058	2,890,185	8,427,989	3,389,514	5,123,488	3,141,124	4,257,106	318,333	1,494,528
1898..	19,004,863	21,206,939	1,285,204	9,332,350	2,231,273	5,842,496	3,555,006	4,879,952	245,289	2,085,398
1899..	22,995,722	25,483,075	2,487,561	10,690,085	2,043,799	7,060,133	3,116,372	5,372,136	610,550	1,890,727
1900..	28,646,053	34,974,961	2,297,883	10,506,357	....	....	....	....	....	....
1901..	28,851,635	36,475,350	....	....	....	....	....	....	....	....

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* Exports from the United States to Mexico, defective, the value of goods exported over railways not being included prior to 1894.

ARGENTINE-CHILE BOUNDARY DISPUTE

IN 1881, after years of bitter dispute, Argentine and Chile signed a treaty defining, as they supposed, the boundary between the two republics. They also agreed to appoint an expert from each government to survey the line according to the definition of this treaty, and to submit any points of difference which might arise between the two experts to a third party for final decision. Apparently this dispute, which had dragged on for forty years and more than once threatened war, was at last settled.

In due time, in 1888, the experts were appointed by each government and set to work surveying and locating the boundary. Immediately, however, the Chilean expert began to interpret the wording of the treaty differently from his Argentine associate In the words of the treaty, the boundary was defined as follows: "The boundary between the Argentine Republic and Chile from north to south as far as the parallel of 52° south is the Cordillera de los Andes. The frontier line shall run in that extent along the most elevated crests of said Cordilleras that may divide the waters, and shall pass between the slopes which descend one side and the other." The Chilean expert proceeded to include within his line, as far as its source, every stream whose waters flowed westward. The Argentine expert, on the other hand, drew his line from summit to summit of the highest crests of the mountain range.

In other words, the Chilean expert regarded the water divide as the boundary, and the Argentine expert the line joining the highest crests of the Andes. It may be that the persons who drew up the treaty of 1881 believed that the water divide and the highest crests were synonymous, but such is often not the case. Repeatedly the Andes are cut by gorges, through which flow rivers rising from 25 to 100 miles east of the Andes. Chile asserts that these rivers and all the territory drained by them belongs to her, and the line as traced by her expert is most carefully drawn to include every spring or stream whose waters flow into these rivers. Argentine, on the other hand, asserts that only the territory to the west of the line drawn connecting the highest peaks belongs to Chile. In long stretches, of course, the crest of the range and the water divide is identical, but then the range will be cut by a river gorge. While the Argentine line skips to the next crest, the Chilean line will dip down to the valleys and often runs in between swamps, and then after a circuit of perhaps a hundred miles, more or less, will come back to the mountain crest.

The differences between the two experts were thus so great that the question was, in 1896, submitted to the British Government for arbitration. It was agreed by each government that until a decision was rendered neither country should take possession of the disputed territory. Great Britain appointed arbitrators, but the years have dragged on and no decision has been rendered. During the past year the Argentine Government claims that Chile has been pushing roads across the mountains, building forts at strategic points, and so intrenching herself as to make her possession of the disputed territory certain in case hostilities should arise. The energetic protests of the Argentine Republic against Chile's action is the cause of the present rupture between the two governments.

To better understand the dispute between Chile and Argentine, we may instance the Alaska boundary dispute between Great Britain and the United States. For years the Alaska boundary was unquestioned, but when certain territory became of value, Great Britain raised the question of uncertainty and claimed a strip to which she held no title and had never claimed title. In the same way with Chile and Argentine. For thirty years the Cordillera de los Andes was the boundary acknowledged by both governments. Then in 1841 Chile sent a colonizing expedition to the Peninsula of Brunswick, in the Straits of Magellan, and claimed the whole Magellan territory. The Argentine Republic protested, but was not sufficiently energetic to settle the question at once. Chile gained possession of a large part of what she then claimed, and the remainder of the claim is still in dispute.

Encouraged by this success, Chile proceeded to claim territory at various points along her entire length which she had never claimed before, and justified her conduct by her interpretation of the complex geographic conditions of the Andes. These claims continually increased until at last war between the republics became imminent. It was averted, however, and the Argentine Republic, at least, thought that everything was settled satisfactorily by the treaty of 1881. The ambiguous wording of that treaty, however, enabled Chile to claim even more than she had ever done before.

The parts of the disputed boundary are three :

1. That relating to the region between parallels 23° and 26° 52′ 45″ latitude south. The territory in dispute here was a tract between two parallel ranges, Argentine claiming the western and Chile the eastern range as the boundary. The dispute regarding this section became so bitter in 1899 that the United States Minister to Argentine, Mr. William H. Buchannan, was asked to act as arbitrator. He settled the difference by awarding to the Argentine Republic eleven-twelfths of the disputed territory in this region.

2. That relating to the boundary from parallel 26° 52′ 45″ to the proximity of parallel 52° latitude south. Sections of this boundary, where the water divide and the crests of the mountains coincide, have been settled by the two governments, but the larger distance is still undefined.

3. That relating to the boundary region close to latitude 52° south. This is the region of the Magellan Strait, and the geographic conditions are most complex. Chile has, however, as previously described, gained a large section of what she originally claimed.

RECENT DECISIONS OF U. S. BOARD ON GEOGRAPHIC NAMES

THE following decisions have been recently made by the U. S. Board on Geographic Names :

Año Nuevo ; bay, creeks, island, and point, San Mateo County, California (not New Year).

Aultmans ; run, tributary to Conemaugh River, Indiana County, Pennsylvania (not Alteman nor Altman's).

Barren ; run, tributary to Jacobs Creek, Westmoreland County, Pennsylvania (not Barnes).

Bentley; post-office and railroad station, Baltimore County, Maryland (not Bentley Springs).

Bonnie Doon ; post-office, Santa Cruz County, California (not Bonny Doon).

Bowlens; creek and mountain, Yancey County, North Carolina (not Bolens).

Brockatonorton; bay, in Chincoteague Bay, Worcester County, Maryland (not Bockatonorton nor Parkers).

Bynum; post-office, railroad station, and run, Harford County, Maryland (not Binum, Bimans, Bynhams, etc.).

Calabazas; creek, tributary to Sonoma Creek, Sonoma County, California (not Calabezas nor Calebezas).

Calabazas is Spanish for *pumpkin*, *calabash*, etc.

Cascade Springs; post village, Fall River County, South Dakota (not Cascade).

Chikasanoxee; creek, tributary to Tallapoosa River, Chambers County, Alabama (not Chickasonoxie, etc.).

Cohobadiah; creek, tributary to the Little Tallapoosa, Gleburne and Randolph Counties, Alabama (not Cohabadia nor Hobadijah).

Craigville; post-office and railroad station, Orange County, New York (not Craigsville).

Cutnose; creek, tributary to the Little Tallapoosa, Randolph County, Alabama (not Cutnoe nor Cut Nose).

Donohoe; railroad station, Westmoreland County, Pennsylvania (not Donahoe nor Donohue).

Doves; cove, in Bush River, Harford County, Maryland (not Dove nor Dove's).

Edmondson; mountain, McDowell County, North Carolina (not Edmonson nor Edmundson).

Gillespie; creek, Ohio County, West Virginia (not Gillaspies, Glasby, nor Glyspie).

Greys; creek, tributary to Assawoman Bay, Worcester County, Maryland (not Gray's, Grey's, nor Rileys).

Griers; hollow, Franklin County, Pennsylvania (not Greer, Greers, etc.).

Honeygo; run, branch of Whitemarsh Run, Baltimore County, Maryland not Herring nor Horning).

La Purisima Concepcion; land grant, Santa Clara County, California (not La Purissima Concepcion).

Lauderick; creek, tributary to Bush River, Harford County, Maryland (not Loderick, Luckwick, nor Ludwig).

Lemaster; post-office and railroad station, Franklin County, Pennsylvania (not Lehmasters nor Lemasters).

Little Falls; city and township, Herkimer County, New York (not Littlefalls).

Lobitos; creek, San Mateo County, California (not Lobatos, Lobitas, nor Lobitus).

Matamoros; town, near mouth of Rio Grande, State of Tamaulipas, Mexico (not Matamoras).

New Windsor; village, post-office, and railroad station, Weld County, Colorado (not Windsor).

Nicks; creek, tributary to Catawba River, McDowell County, North Carolina (not Nix).

Outward Tump; island, Chincoteague Bay, Worcester County, Maryland (not West Clump).

Palomar; mountain, in northern part of San Diego County, California (not Smith).

Parnell; knob, at south end of North Mountain, Franklin County, Pennsylvania (not Parnel).

Phillipston; post-office and railroad station, Clarion County, Pennsylvania (not Philipston).

Pilarcitos; canyon, creek, and lake, near Pillar Point, San Mateo County, California (not Pillarcitos).

Pit; river, tributary to the Sacramento River in northern California (not Pitt).

This name, applied as early as 1850, is thus explained in Pacific Railroad Report, vol. VI, p. 64:

"We passed many pits about six feet deep and lightly covered with twigs and grass. The river derives its name from these pits, which are dug by the Indians to entrap game. On this account Lieutenant Williamson always spelled the name with a single t."

Plum; creek, tributary to Cheyenne River, Fall River County, South Dakota (not Plumb).

Price; creek, Yancey County, North Carolina (not Price's).

Price Creek; post-office and township, Yancey County, North Carolina (not Price's Creek).

Purisima; creek and post-office, San Mateo County, California (not Purissima).

Putah; creek and township, Yolo County, California (not Puta).

Ramsaytown; post-office and township, Yancey County, North Carolina (not Ramseytown).

Reddens; run, Indiana County, Pennsylvania (not Bedding).

Reems; creek, Buncombe County, North Carolina (not Reams, Reem, nor Rims).

This is a reversal of the decision Reem, made January 9, 1901, and published on page 87, no. 2, vol. xii, of this Magazine.

Robins; creek and marsh, Chincoteague Bay, Worcester County, Maryland (not Robbins, Robin's, nor Robin).

This is a reversal of the decision Robin, made in May, 1901.

Robins; point, the end of Gunpowder Neck, Harford County, Maryland (not Robbins nor Robin).

Salisbury; township, Lehigh County, Pennsylvania (not Salsberg, Salsburg, nor Salsbury).

Sankaty; head or bluff, at east end of Nantucket Island, Massachusetts (not Sancoty, Squam, nor Sweseckechi).

Stansbury; creek, branch of Middle River, Baltimore County, Maryland (not Stansberry).

Stansbury; point, Back River, Baltimore County, Maryland (not Stansberry).

Stickel; hollow, Perry township, Fayette County, Pennsylvania (not Stickle).

Swaderick; creek, tributary to Gunpowder River, Harford County, Maryland (not Sundricks, Lauderick, nor Ludowick).

Teays; post-office and valley, Putnam County, West Virginia (not Teayes, Teayse, nor Teazes).

Two Lick; creek, post-office, and railroad station, Indiana County, Pennsylvania (not Two-Licks, Twolick, etc.).

Vailsgate; post-office and railroad station, Orange County, New York (not Vailgate nor Vail's Tollgate).

Vieques; island off eastern end of Porto Rico, West Indies (not Biequi, Crab, Viequez, etc.).

Walker; post-office and railroad station, Baltimore County, Maryland (not Walkers Station nor Walkers Switch).

Watson; creek, on east side of Gunpowder River, Harford County, Maryland (not Waterson, Waterton, nor Watsons).

Weisenberg; post-office and township, Lehigh County, Pennsylvania (not Weissenburg, etc.).

Welsh; post-office and railroad station, Chambers County, Alabama (not Welch).

Wharton; creek, Madison County, Arkansas (not Warton's nor Whorton).

Wharton Creek; township, Madison County, Arkansas (not Whorton Creek).

Whites; run, Indiana County, Pennsylvania (not Whites Spring).

Yeates; mountain, Yancey and Madison Counties, North Carolina (not Yates).

GEOGRAPHIC NOTES

HON. JOHN W. FOSTER ON MEXICO

THE phenomenal economic and social progress of Mexico during the last twenty-five years is clearly described by Mr. Foster in the leading article of this number. No man living is so well fitted to contrast the new Mexico with the Mexico of twenty-five years ago. General Foster began his diplomatic career as Minister to this Republic in 1873, and for seven years represented the United States. After an interim of twenty years, during which he was Minister to Russia, to Spain, and Secretary of State, he again visited Mexico, this time as the guest of the nation. The present prosperity of the young Republic impressed him on every side.

MAP OF THE PHILIPPINES

THROUGH the courtesy of Gen. A. W. Greely, the NATIONAL GEOGRAPHIC MAGAZINE is able to publish as a supplement to this number the magnificent map of the Philippines prepared under his direction by the U. S. Signal Office.

Every town or hamlet known by the Jesuits or reported to the War Department by its many officers throughout the islands is indicated on the map. It is a compilation of everything now known about the Philippine Archipelago. Sheet I gives the Northern Philippines and Sheet II the Southern Philippines, as officially divided by the United States Government.

A glance at the map shows how much exploration is needed in large sections. For instance, on the Island of Mindoro only a few names along the coast are given. The interior of the island is a blank.

The tremendous progress made by the American Government in the islands is graphically illustrated by the red lines, indicating cables, telegraphs, and telephones, which penetrate to nearly all corners of the archipelago. Nearly seven thousand miles of wire are now strung, whereas three years ago there was not one mile in service.

All the telegraph lines are owned by the Government and operated by a Government department—the United States Signal Corps. The stations noted as commercial stations are open to messages of a private and commercial character, while from the stations noted as military only messages of a military nature can be sent.

This map is the first map of the Philippines that has been prepared by American officials. The spelling of the names is that adopted by the United States Board on Geographic Names.

It may not be inappropriate to remark that the War Department printed an edition of only 400. The demands of the army posts in the Philippines and in the United States exhausted nearly the entire edition, so that only a few remain for public distribution. The National Geographic Society was, however, granted the use of the plate and has printed a large edition, so that each of its members may receive a copy of what is really the only up-to-date presentation of all that is now known of the geography of these islands.

GOLD MINING CONCESSION FOR NORTHEASTERN SIBERIA

THE expedition of geologists recently sent out to the Chukches Peninsula by Von Larlarski, who owns the concession for gold mining in that region, report that the geological formation of the peninsula is like that of Cape Nome opposite, and that much gold is to be found there. The Russian Government has been much criticised by the newspapers for granting an exclusive concession to one individual. The criticism has, in fact, been so bitter that the government has been obliged to publish a three-column official defense of its action. It states that a concession was the only means of protecting the rich district from being invaded by American prospectors. The country is so far distant and so large that it is impossible to send troops there, but a strong Russian syndicate, for its own interests, would defend the property and keep out American and foreign gold-hunters.

There is probably little truth in the report that Senator Clark or any American capitalist has been granted concessions for mining in any part of Siberia.

By law all gold mined in Siberia and Russia must be sold to the government, which buys it at the ruling rates. It is a criminal offense to sell to any one else.

RAILWAYS OF THE WORLD

A LARGER addition was made to the railway mileage of the United States in 1901 than in any preceding year since 1890. The steam railways of the United States now aggregate about 200,000 miles, and those of the entire world nearly 500,000 miles. Figures published by the Treasury Bureau of Statistics give the number of miles of railway in operation in the United States at the end of 1900 as 194,321, and adding to this the 5,057 miles built in 1901 brings the grand total for the United States to 199,378 miles. This does not include railways operated by electricity, of which the mileage, exclusive of street and suburban roads, is now considerable and rapidly increasing.

The total miles now open for traffic in the entire world are estimated at 484,348, of which 220,657 miles are in North America, 168,605 in Europe, 35,580 miles in Asia, 28,364 in South America, 15,860 in Africa, and 15,282 miles in Australasia. The United States stands first, with 199,378 miles. Russia has 34,852 ; the German Empire, 31,934; France, 26,613; India, 25,035; Austria-Hungary, 22,919; Great Britain and Ireland, 21,700; Canada, 17,657; British Australasia, 15,266; Argentina, 10,419; Italy, 9,810; Mexico, 9,603; Brazil, 8,718, and Spain, 8,300 miles.

Of the half a million miles of railway in the world, the Bureau of Statistics estimates that about one-third are owned by the governments of the country in which they are located. About nine-tenths of the railways of Germany are owned by the national or state governments ; about two-thirds of those of Russia are owned by the government, and nearly one-half of those of Austria-Hungary are also owned by the government. A large proportion of the railways of France will become the property of the government about the middle of the present century. In Italy nearly all of the railroads are owned by the government, but are operated by private companies which lease the lines from the government. In Australasia nearly all of the railways are owned by the governments of the various colonies, and in India a large proportion of the 25,035 miles in operation is owned or guaranteed by the Indian Government.

EMIGRATION FROM SIBERIA

MUCH is being written about the many thousands constantly pouring into Siberia, but little is heard in America of the great numbers who are compelled to return to Russia, having been unable to establish themselves in Siberia. The Russian papers during the past year have been severely criticising the arrangements of the government for persons seeking to colonize Siberia. It has been frequently stated in these papers that from 35 to 50 per cent of Russians entering Siberia have returned within a few months, unsuccessful. In self-defense the Russian Government has therefore published figures showing the number of persons entering and leaving Siberia during the first nine months of 1901.

During this period 77,774 immigrants entered Siberia, and of these 25 per cent, or 19,728, returned within a short time. The reason of such a large proportion as one-fourth returning is explained as follows: During the past two years the crops have failed each season. Of the 19,000 who returned between January 1 and September 20, 1901, 16,000 had come from the grain provinces of Russia. Secondly, the steppe lands of Siberia along the railway are almost entirely taken up and only the forest lands remain. But the majority of the immigrants are from the steppe lands of Russia and, being unused to clearing forest lands, soon became discouraged and returned.

The Russian Ice-breaking Steamer Yermak, under command of her designer, Vice-Admiral Makarof, has returned in safety to Cronstadt, after a cruise of three or four months in the Arctic seas. In a review of the summer's work of the steamer, the Cronstadt *Messenger* says that she completed an accurate survey of the western coast of Nova Zembla from Sukhoi Nos to the Admiralty Peninsula, and made five voyages back and forth between Nova Zembla and Franz Josef Land.

The scientists who accompanied Admiral Makarof made interesting and important soundings and observations in all that part of the Arctic Ocean, and brought back 525 jars of zoölogical specimens obtained by means of the dredge and the sounding line, as well as large collections of flowers, minerals, and diatoms from the Arctic lands visited and explored. In the heavy ice northwest of Nova Zembla and off the coast of Franz Josef Land the *Yermak* made her way without difficulty.

The Foreign Population of the United States.—The Census Office has just published the number which each country of the world has contributed to our foreign-born population. The five nations having the largest representation are the same as in 1890, though the first three, Germany, Ireland, and England, show a large falling off. Italy is now in the sixth place, succeeding Scotland, which was sixth ten years ago. The following table shows the representation of each country:

Country of birth.	1900, Exclusive of Alaska and Hawaii.	1890.	Increase.
Total foreign born...	10,356,664	9,249,547	1,107,117
Germany	2,666,990	2,784,894	117,904*
Ireland	1,618,567	1,871,509	252,942*
England	841,967	908,141	66,174*
Canada (English)	785,958	678,442	107,516
Sweden	573,040	478,041	94.999
Italy	484,207	182,580	301,627
Russia	424,096	182,644	241,452
Canada (French)	395,297	302,496	92,801
Poland	383,510	147.440	236,070
Norway	336,985	322,665	14.320
Austria	276,249	123,271	152,978
Scotland	233,977	242,231	8,254*
Bohemia	156,991	118,106	38,885
Denmark	154,284	132,543	21,741
Hungary	145,802	62,435	83,367
Switzerland	115,851	104,069	11,782
Holland	105,049	81,828	23,221
France	104 341	113,174	8,833*
Mexico	103,410	77,853	25,557
Wales	93,682	100,079	6,397*
China	81,827	106,688	24,861*
Finland	62,811	....	....
Portugal	30,618	15,996	14,622
Belgium	29,804	22,639	7,165
Japan	25,077	2,292	22,785
Roumania	15,041	....	....
West Indies, except Cuba and Porto Rico.	14,433	(*a*)	....
Asia, N. S.	11,908	2,260	9,648
Cuba	11,153	(*a*)	....
Turkey	9,933	1,839	8,094
Atlantic islands	9,784	9,739	45
Greece	8,564	1,887	6,677
Born at sea	8,229	5,533	2,696
Spain	7,072	6,185	887
Australia	6,851	5,984	867
South America	4,761	5,006	245*
Central America	3,901	1,192	2,709
Luxemburg	3,041	2,882	159
Africa	2,552	2,207	345
Europe, N. S.	2,263	12,579	10,316
India	2,050	2,143	93*
Pacific islands, except Philippine Islands	2,049	2,065	16*
Great Britain, N. S.	111	951	840*
Sandwich Islands (*b*)	....	1,304	....
Other countries	2,558	479	2,079

(*a*) Total for West Indies and Cuba in 1890, 23,256.
(*b*) Native born in 1890.
* Decrease.

The East Siberian branch of the Imperial Russian Geographical Society celebrated, at Irkutsk, on the 29th of November, 1901, the semi-centennial anniversary of its existence. Siberian delegations to the number of sixty were present; letters and congratulatory addresses were read from the parent society and its branches, from all the Russian universities, from the women of Siberia, and from the native students in the University of Tomsk, and more than two hundred telegrams of greeting were received from scientific societies, museums, city councils, zemstvos, and distinguished geographers in all parts of the Empire.

The governor-general read a telegram of congratulation from His Imperial Majesty the Tsar, which was welcomed with great applause, and in the presence of the members of the society and a great throng of spectators, the president, Mr. Kakovetski, unveiled the names of the distinguished Russian explorers and geographers Cherski, Turchaninof, Przhevalski, and Maximovich, which had been cut in the cornice of the stone façade of the Society's beautiful building. In the evening a jubilee dinner was given in the hall of the city council, and the flag-decorated house of the Society was brilliantly illuminated with colored electric lights.

Butter Exports from Siberia.—The St. Petersburg *Gazette* says that the export of butter from western Siberia is beginning to assume colossal proportions. In two months (June 15 to August 15) of 1901, for example, 702 car-loads (14,400,000 pounds) of Siberian butter were received by rail at the single Russian port of Riga, and were shipped by a single firm (Helmsing and Grimm) to London, Copenhagen, Hamburg, and other west-European cities.

In the latter part of September, at Kurgan, in the province of Tobolsk, there was an exhibition of milk products at which were shown samples of butter from more than 300 Siberian butter makers and dealers. In connection with the exhibition, there was held a convention of west-Siberian butter-makers, which resolved to urge an increase in the number of primary schools for the education of the common people, to hasten and facilitate the transportation of butter from western Siberia to the European market, to appoint sales agents in Great Britain, to combat in every possible way the spread of contagious and infectious diseases among cattle, and to establish a newspaper devoted to the interests of Siberian butter makers and dealers.

Siberian Mammoth.—The expedition sent out by the St. Petersburg Academy of Science to obtain the remains of the male mammoth discovered in northeastern Siberia is well on its return journey. It is stated that the hide of the mammoth is in an almost complete state of preservation, and in the stomach and teeth remains of undigested food were found.

Russian Polar Expedition.—A Russian capitalist has given $70,000 for the organizing and equipment of a new Russian polar expedition, which will sail early in the summer of 1902 on the ship *St. Panteleon*, and will spend two years in the Arctic regions.

J. E. Spurr, of the U. S. Geological Survey, is making a geological survey of Macedonia and Albania at the request and expense of the Sultan of Turkey.

The Commercial Geography, by Cyrus C. Adams, reviewed in the last number of this Magazine, has within one month of publication been introduced into over 300 cities and towns.

GEOGRAPHIC LITERATURE

Constantinople and its Problems. By Henry Otis Dwight, LL. D., with illustrations. New York: Fleming H. Revell Company.

Of the competency of Dr. Dwight to write a book on this subject there can be no question. Born in Constantinople, he has there spent the larger part of an active and useful life. He knows well the various languages, beliefs, and customs of its inhabitants. Moreover, he is a man of quick mind and genial temperament, sure by contact with men of all classes to pile up a store of rich experience. In his honesty as a narrator, one must have full confidence. One may sometimes disagree with his opinions, but when he tells us something occurred we know he believes it occurred just as he said it did. He is not a man to pad or adjust even his anecdotes.

With this equipment the reader expects from him a valuable treatise on so important a subject as "Constantinople and its Problems." But the author is handicapped by two disadvantages. The first is that a man who lives and expects to live in Constantinople cannot deal with such a subject, his name being known, with frankness and unreserve. The political atmosphere of Constantinople does not favor free expression or the pushing of syllogisms to their conclusion. The second disadvantage is that he writes from a purely missionary point of view. This may be the highest point of view, but it is by no means the only one, nor is it the broadest. So the first disadvantage robs the book of its largest possible value, and the second disadvantage narrows its breadth.

The book is interesting from beginning to end. It conveys much information as to habits, customs, and ideas. It is chatty, rather than profound, and when dealing with problems or with geographic or political conditions is by no means equal to what Dr Dwight is capable of writing.

Edwin A. Grosvenor.

Constantinople—The Story of the Old Capital of the Empire. By William Holden Hutton, Fellow of St. John Baptist College, Oxford. Illustrated by Sydney Cooper. New York: The Macmillan Co.

This book contains nothing new, and little which has not been printed many times. The author has visited Constantinople, but his work is none the less of the sort which a compiler may easily produce at home, a few authorities being employed as sources of information. Pages 1 to 230 sketch the story of Constantinople; pages 231 to 336 indicate the more prominent objects of interest. In the historical summary the treatment is sympathetic, though unduly theological, and but small appreciation is shown of the city's commercial and political importance and of its great part in the Middle Ages. Whatever excellence the book possesses is constantly marred by carelessness of style and statement. There is apparently no rule for orthography. Thus we have Stamboul and Stambûl, St. Sophia and S. Sophia, kapousi and kapoussi, Pantocrator and Pantokrator, Valideh, Validé, and Valide, "os" and "us" used as termination of the same Greek word, and so on *ad infinitum*. Some of the slips amuse as well as surprise. Thus the bas-relief of the Emperor Theodosius holding the wreath to crown the victor in the chariot race, opposite page 324, is gravely entitled "The imperial box during the performance of a ballet!" On page 6 it is stated, "The seven hills . . . stretch . . . from east to west," regardless of the fact that six of the seven run north and south, and that the seventh is a rough triangle. Execrable proof-reading is doubtless largely responsible for the numerous blunders on the outline map at the end. The most attractive and perhaps the most accurate feature of the book is its dainty illustrations by Mr. Sydney Cooper.

EDWIN A. GROSVENOR.

Primitive Man. By Dr. Moriz Hoernes. Translated from the German by James H. Loewe. With illustrations. New York: The Macmillan Co. $0.40.

This volume presents in compact form what is known of primitive man. The style is uninteresting, so that it is doubtful if the book will appeal to any except the professional anthropologist.

The Wisconsin Geological and Natural History Survey has published a bulletin entitled "The Clays and Clay Industries of Wisconsin," by Dr. E. R. Buckley (Bulletin VII (part 1), Economic Series, No. 4). Wisconsin possesses clays which are adapted to the manufacture of all kinds of brick, common and ornamental, and also for earthenware and porcelain. Hitherto these resources have not been much developed, owing to the great forests, which furnished abundance of timber for construction. The increase in the price of lumber, because of decrease of supply, will probably soon encourage the manufacture of bricks.

NATIONAL GEOGRAPHIC SOCIETY

PROCEEDINGS

MEETINGS OF THE SOCIETY:

November 29, 1901.—President Graham Bell in the chair.

Dr. Arthur P. Davis, Hydrographer of the Isthmian Canal Commission, read a paper on "The Best Isthmian Canal Route." Mr. Davis treated the question from the commercial and economic points of view only. Commercial and economic arguments, Mr. Davis believed, were largely in favor of the Panama route. Further notice of this paper will appear later in this Magazine.

December 13.—President Graham Bell in the chair.

"The Northwest Boundary" was the subject of three papers; Mr. C. H. Sinclair, of the U. S. Coast and Geodetic Survey, and Messrs. E. C. Barnard and Bailey Willis, of the U. S. Geological Survey. The papers will be published later.

LECTURES:

December 6.—President Graham Bell in the chair.

Prof. A. C. Haddon, of Oxford, England, gave an illustrated address on "The Natives of Borneo."

December 22.—President Graham Bell in the chair.

Hon. E. J. Hill, member of Congress from Connecticut, gave an address on the "Trans-Siberian Railway," which will be published in the February number of this Magazine.

ANNOUNCEMENTS

POPULAR LECTURES:

January 17, 1902.—"American Progress and Prospects in the Philippines;" Gen. A. W. Greely, Chief Signal Officer, U. S. Army.

General Greely has returned to America after an extended tour among the Philippine Islands. As an example of American progress in the Philippines, it may be stated that 6,000 miles of telegraph lines and cables have been put up in these islands by the U. S. Signal Corps in the three years since the capture of Manila. Telegraph and cable connections are now complete between the northern coast of Luzon and Jolo, 1,000 miles to the south.

January 31.—"Present Conditions in South Africa;" James F. J. Archibald, the well-known war correspondent.

Mr. Archibald was with the Boer army in the South African war until the occupation of Pretoria. Later he was with the British army for several months, and has thus seen the country from both sides. Previous service in the Chinese-Japanese war, with General Miles in various Indian campaigns, in the Santiago campaign, and with the British forces in the Sudan in 1899, had given him unusual experience for accurate and practical observation.

MEETINGS OF THE SOCIETY:

January 10, 1902.—Annual Meeting, Reports, and Elections.

January 24.—"The Magnetic Survey of the United States," Dr. L. A. Bauer, U. S. Coast and Geodetic Survey; "Ocean Currents," Mr. James Page, U. S. Hydrographic Office.

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THE NATIONAL GEOGRAPHIC MAGAZINE

A TRIP THROUGH SIBERIA*

BY EBENEZER J. HILL, MEMBER OF CONGRESS FROM CONNECTICUT

IT has been my pleasure during the present year to make a trip around the world, starting from New York and journeying westward until I again reached New York, five months and fifteen days later. The route was through Hawaii, Guam, the Philippines, China, Japan, Korea, and by the Amur River and Trans-Siberian Railroad across Asia into Europe.

It is of this latter portion of the trip that I have been requested by your Society to give some reminiscences, supplemented by views of the country, both mental and photographic. Its history can be quickly told, for it illustrates the Russian saying that "*the empire only goes where the Cossack can march dryshod.*"

THE RUSSIAN CONQUEST OF THE AMUR VALLEY AND MANCHURIA

Its conquest was begun in 1580 by a robber chief named Yermak, who crossed the Urals and, defeating the Tatars, gave their lands as his own peace offering to the Russian Emperor, Ivan the Terrible. For sixty years the Cossacks fought their way eastward until they reached the Okhotsk Sea, easily routing the scattered tribes of the northern country; but it was not until 1650 that Khabarovsk, a Russian farmer, led them into the Amur Valley. His memory has been perpetuated in the name of the flourishing city which stands today at the junction of the Amur and Usuri Rivers. The Manchus were a warlike people, and the Black Dragon River, as they called the Amur, was their northern boundary. After a contest which continued forty years, they drove the Russians back and held undisputed possession for a hundred and sixty-six years, until 1854, when General Muravieff notified China that, with or without her consent, he proposed to resume control of the Amur River. In 1855 he reëstablished the Cossack stations its entire length, and in 1860, by the treaty of Aigun, this splendid valley of a river navigable for two thousand miles, and with it the whole Pacific coast of Manchuria, reaching westward to the Usuri River and southward to Korea, was given up to Russia without a struggle.

That one accession made Siberia what it is today. Without it, it was

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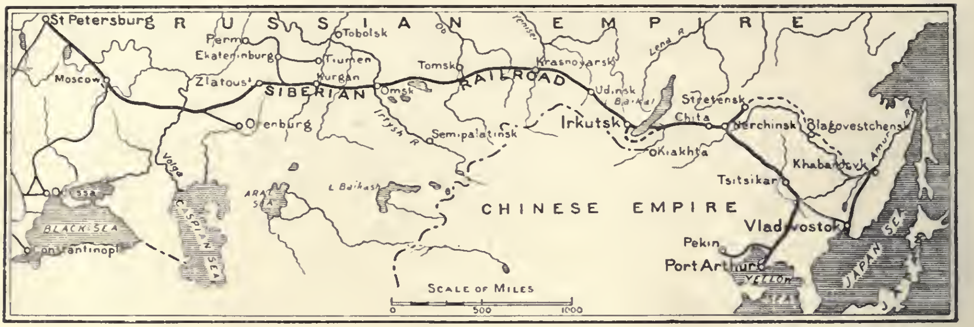
*An address before the National Geographic Society, December 20, 1901.



Sketch Map of Siberian Railway

and would have remained a trackless waste. With it, it will be an empire which within a century will exercise more influence in the world's affairs than European Russia ever has, for it is sure to be the dominant power in the Orient, where half the population of the world is found, and it is not impossible that in some distant future the United States of North America may clasp hands across the Pacific with the United States of Northern Asia.

In the public park in Khabarovsk, on a high bluff overlooking the Amur and Usuri Valleys, there stands a splendid statue of General Muravieff. His back is turned upon the conquests of the past and he is looking *at* and pointing *toward* Manchuria.

As I sat and gazed at it and thought of the events of the past two years, I fancied I could see the bronze eyes twinkle and the lips move with a shout of triumph, *for the Cossack has marched again*, and by fire and sword almost to the Chinese wall, has established Russian control over all Manchuria.

ITS VASTNESS

Few people realize the immensity of Siberia, for it is impossible for the mind to grasp the meaning of five million five hundred thousand square miles. To think of a single state stretching through one hundred and thirty degrees of longitude and covering thirty-two degrees of latitude and equalling one-ninth of the land surface of the globe is almost inconceivable.

Let us measure it by countries with which we are familiar. Take all of the United States between the oceans and add Alaska, the Philippines, Hawaii, and Porto Rico; then add England, Ireland, Scotland, and Wales; then cross the English Channel and take France, Belgium, Holland, Denmark, Norway and Sweden, Germany, Switzerland, Italy, Spain, and Portugal, Austria, Greece, Turkey, Bulgaria, Roumania, and Servia, making all of Europe except Russia, and you could put them *all* in Siberia and have land enough left to make thirty-five states like Connecticut, and Manchuria will make seventy more.

SURPRISES

I had thought of Siberia as a convict settlement only, with a small population composed largely of criminals and political exiles. I found it a country of nearly nine million people, 97 per cent of whom were either natives or voluntary immigrants, with the exile system discontinued or transferred to the island of Sakhalin, and all, as a rule, earning better wages, living in better houses, having better food and clothing, and enjoying much more political and religious liberty and personal freedom than in European Russia, and indeed in some other European countries in whose behalf our sympathies have not been evoked.

I had believed it to be a frozen wilderness and a desert waste. The portion through which I traveled was a land like Minnesota, the Dakotas, and the foothills of the Rockies, where wheat and rye and vegetables matured; where strawberries, currants, and raspberries abound; where sheep, horses, and cattle graze unsheltered throughout the year, and where a greater extent of virgin forest of splendid birch and pine is found than the whole area of the United States. I was told, and I believe it is true, that straight through from the Kingan Mountains to the Urals for about 400 miles north of the Trans-Siberian Road like conditions prevailed, and north of this tillable land was 400 miles more of unbroken forest before the frozen tundra or Arctic waste was reached.

I expected to find in every town a convict prison full of exiles and criminals. With the exception of two convict barges floating down the Amur on their way to Sakhalin, I saw no trace of the system, but I did see in every town and village, no matter how small or humble, the dome of a Russian church, and in the larger cities Catholic and Lutheran churches as well.

I had been told that Russian officials were peculiarly susceptible to tips and fees, and of course expected to be fit plunder for hotel-keepers, porters, and all others with whom a traveler comes in contact; but after a somewhat extensive experience in most of what we call the civilized countries of the world, I want to record as my opinion that nowhere have I had so courteous treatment, so generous assistance, and so hearty welcome as in Siberia, both from the officials and civilians as well. I do not think that this was exceptional in my case, but that any American traveler with proper credentials and without a mission to reconstruct the government and reform all of its abuses at once would have the same experience.

A Steamer Landing on the Amur

I was cautioned to be an American and nothing else in Russia, and while I did not need the advice, I followed it and found in doing so that as a nation and as individuals we had the confidence, respect, and regard of all.

But the greatest surprise to me was the country itself, so wholly unlike what I had expected, and since I have returned to my home and read the descriptions of it, written before the railroad was built, I have wondered whether I could have been mistaken in my judgment of it.

NOTES ON THE GENERAL GEOGRAPHY OF SIBERIA

It was my practice daily to jot down notes of the physical geography and general appearance of the country through which we passed, not as a connected diary, but as bench-marks, so to speak, for future reference. Let me read them to you, that you may judge for yourselves what Siberia is along the line of the Trans-Siberian Railway and in the Amur Valley.

Arrived at Vladivostok July, 2, 1901. Left Vladivostok 9 a. m., July 4. Very soon after leaving Amur Bay the road enters the valley of a river, and; judging by the soil, grass, and flowers, we seem to be transported into a rich river valley of our own West. Here and there is an apparently thriving village, and prosperous farms are intermingled with virgin prairie. A great change has evidently come here from Russian occupation. As we go north the country improves; magnificent stretches of well-watered prairie, wheat farms, large herds of cattle, and fine grass. The depots are well-built, pretty wooden cottages, and in each town, on the highest point, the domes of the Russian churches are seen.

Friday, July 5.—The country has changed, and we are in the timber. Birch shows where pine has been cut off, and the hills in the distance indicate heavy timber. A train composed almost wholly of cars loaded with 3 x 10 white pine tells of pine trees somewhere, and gnats and mosquitoes and flies tell of timber. It is getting very warm, and summer clothes will be in order. At 4.30 Khabarovsk came in sight. The city here is to be fine. It is evidently new. The streets are wide and straight. It spreads over high bluffs, from which one looks down on the Amur River, which is a mile and a half wide here.

Saturday, July 6.—Left Khabarovsk at 6.30 p. m.

Sunday, July 7.—Mosquitoes and flies abound. The Amur is a wonderful river. It is more than a mile wide and seems like a great lake. Thus far it flows through a prairie country and splendid tillable land, which will some day raise the world's wheat supply; Russia on the north bank, China on the south. Russia holds Manchuria and will never let it go. The country is a splendid one. Mountains are occasionally seen in the distance, but here all is prairie, and the river banks show at least ten feet of soil.

Monday, July 8.—Surroundings similar to those of yesterday. Occasionally, but rarely, we pass a small settlement. All through the afternoon and evening we were passing through the Kingan Mountains. Here they are a series of hills 500 to 800 feet high. The scenery is fine, the mountains coming boldly down to the river. I am reminded of the Fraser River, especially when we come to a mining camp, where the Russians first attacked the Chinese and drove them out.

Tuesday, July 9.—This morning we are out of the mountains

A Woodyard on the Amur River

and in an alluvial country again. The river still holds its great width.

Wednesday and Thursday, July 10 and 11.—Surroundings similar to foregoing.

Friday, July 12.—Reached Blagovestchensk; city a fine one; good buildings, wide streets, and excellent stores.

Saturday, July 13.—Left Blagovestchensk at 8 p. m.

Sunday, July 14.—Evening. The banks are again steep, and low mountains appear on both sides of the river. The current runs very swiftly.

Monday, July 15.—Noon: Mountains bordering river on the south side, prairie on the north. Evening: Mountains change to the north side.

Tuesday, July 16.—The enormous horseflies, fully an inch long, have been exceedingly annoying all day.

Wednesday, July 17.—The most interesting thing in natural scenery has appeared today—the so-called White or Tsaigon Mountains. They are uneven hills of sand rock, at least 500 feet high, bordering the river, and continually breaking off and wearing away. They show the strata, and layers are seen which seem to be on fire. The smoke is visible at points in the daytime, and it is said that fire is seen at night. I think that instead of being burning coal, as claimed, it is discoloration from hot springs, which exude vapor like the mud springs of the Yellowstone. Flies and mosquitoes abound.

Thursday and Friday, July 18 and 19.—River very shallow and progress slow. Smoke from burning forests somewhere, very dense, compelling us to stop.

Sunday, July 21.—Reached Albasin and Reinovo.

Monday, July 22.—Day delightfully cool. The scenery, while not remarkable, has been more attractive than before.

Stuck on the Amur

Tuesday, July 23.—Reached Povrosk, the junction of the Shilka and Aigun Rivers. The character of the country thus far can be somewhat judged by the fact that though we have sailed the Amur 1,200 miles nearly, we have not seen a single waterfall on either bank.

Evening: The Shilka thus far promises to be much more picturesque than the Amur, the mountains higher and banks bolder. The river runs in a single course between high banks, the views are far-reaching and the mountains, though not grand, are beautiful.

Wednesday, July 24.—The scenery still continues pretty, but not what would be considered grand or magnificent.

Thursday, July 25.—Fenced land and here and there a good farm can be seen. We are evidently approaching a more settled country. The scenery has been good today, and all indications have been those of a good hill-farm section.

Friday, July 26.—Arrived at Stretensk at 12.30. It is a small place of

Immigrants Waiting for the Amur to Rise

two or three thousand people, and is the head of steamboat navigation. Pleasantly located, it has all the appearance of one of our frontier towns.

Saturday, July 27.—There was a sharp frost this morning. I am told that the thermometer shows 60 to 70 degrees below zero here in the winter. Left Stretensk by rail at 9.45 a. m.; have been riding all day up the valley of the Shilka and then the Ingoda. The views are very pretty, the country a superb one now; fine farms, excellent cattle and many of them, and good grazing. Everything looks like June here.

Sunday, July 28.—All day we have been passing through a fine country, with frequent villages, good-looking farms, and one city, Chita, a place of 22,000 people. Will enter the Yablonoi Mountains tonight.

Milk and Bread Sellers on the Amur

Monday, July 29.—Weather very cold this morning. We are in the western foothills, and the water in the little river by the side of which the track runs is flowing westward to Lake Baikal. The soil is light and sandy, and the prevailing trees are pine. Later we come into the country of the Buriats, a pastoral people, formerly Mongols, with the Chinese features, queue, and dress, except that they wear round hats with turned-up brims. The country here is fine.

Tuesday, July 30.—Arrived at Lake Baikal. Weather rainy and lake rough. It is a large body of water, said to be about 50 miles wide and 400 miles long, and very deep, in some places 4,500 feet. As far as we could see, the shores are bold and rocky. Reached Irkutsk, 40 miles west of the lake, at 12 midnight. It is a city of 35,000 people. It is situated on both sides of the Angara River, which flows out of Lake Baikal, and apparently is in a flat country.

Friday, August 2.—Left Irkutsk at midnight.

Saturday, August 3.—We have been riding all day through a splendid prairie country with just grade enough for good drainage. White birch on both sides of the track and dense pine forests a little distance away. Here and there a small farm, now and then a river—the paradise of farmers and cattle-raisers. The forests are clean, no underbrush, but grass and ferns carpeting the ground under the trees.

Sunday, August 4.—Country still continues fine. Undulating prairie as far as the eye can reach, with plenty of timber scattered about. I am surprised at the extent of cultivation out here and the frequency and size of towns. The soil seems very fertile, and grain looks well.

Immigrants on the Amur

Bank of the Amur Showing the Fertile Soil

Monday, August 5.—Early this morning we came to Omsk, and, crossing a long bridge over the River Ob, we came into a flat prairie country. The soil is rich, the grass good; few trees, and these small, more like bushes. It is magnificent farm land. Every little while we see a herd of horses, cattle, and sheep grazing, and a Tatar boy sitting on horseback and keeping them together. The towns are larger than before, but less frequent. This is genuine prairie country.

Wednesday, August 7.—Same as yesterday, only apparently more fertile. Not much cultivation but more grazing. This is the country of the Kirghiz. They are cattle-raisers. The prairie is splendid, as good as I ever saw. Lakes and large ponds abound, and in the absence of rivers receive the drainage.

Thursday, August 8.—Awakened this morning early by the tug of the cars on the upgrade, and, going out, found that we were climbing the eastern slope of the Ural Mountains. An occasional pretty view rewarded me for my early rising. The Urals here are about like the Berkshire Hills. Grass is cut almost to the top. The passage is not difficult. We are now in Europe, having passed the boundary post in the night. The Administrative boundary is some 200 miles eastward of Kurgan, where, officially, Siberia begins. All the morning we were running down the valleys, with an occasional pretty, far-reaching view. There is nothing specially attractive about the scenery. In the afternoon we came into a splendid farming country, with the peasant villages and large estates; splendid farms, wretched huts; wealth for the landowner, misery and dire poverty for the land-worker. The density of population is much more apparent.

An Oil-burning Locomotive on the Siberian Railroad

Friday, August 9.—Today we are in a country of no wood. As far as the eye can reach, the steppe is brown and bare after the harvest. The villages are numerous, but so dry everywhere, and apparently dire poverty. The houses are hardly distinguishable from the grain stacks. Roofs of straw, and often mud walls, characterize the houses. Bricks of peat, piled in pyramids drying in the sun, constitute the fuel for the winter.

Noon.—Have just crossed the Volga, a magnificent river. Later we suddenly ran into a low, swampy section of country and at once splendid tall pine trees appeared and the rest of the day the woods prevailed.

Saturday, August 10.—Today the country is better and more diversified. Apparently few people live outside of the towns and peasant villages. Vast tracts are farmed, enormous herds of cattle roam the grazing land, but the man behind the hoe is in poverty and hunger.

We arrived at Moscow at 7 p. m.

RESOURCES AND DEVELOPMENT

Whatever I have given of description of Siberia may be applied in added degree to Manchuria, which is now and hereafter will be a part of Asiatic Russia. I say in added degree, because of its more southern location and consequent milder winter climate. Both countries possess a fertile soil, abundant timber, navigable water-courses, coal, iron, copper, gold—indeed all of the resources which properly developed tend to make a nation great and prosperous.

Into and through such a country the Russian Empire has built a railroad which is as marvelous as the country through which it goes. Undoubtedly planned as a military road, its freight and passenger traffic has so enormously increased that there is no longer a question of its present and future financial success. From its beginning a steadily increasing tide of immigration has flowed into Siberia, not only by rail from central and northern European Russia, but by means of the Russian volunteer fleet through the Suez Canal and the Pacific ports until Vladivostok, which forty years ago consisted of four Chinese fishermen's huts, is now a flourishing city of fifty thousand souls, and Khabarovsk and Blagovestchensk are not far behind in wealth or population. At first a Cossack occupation at strategic points, then an assisted immigration of the former serfs, now an eager and enthusiastic search for wealth in the fertile soil and rich mineral resources of a new country. To each family moving into the Amur and maritime provinces an allotment of 269 acres of land is made, and into the central and western provinces forty acres for each male immigrant, with certain tax exemptions and lessening of military service in both cases. The fare to incoming settlers is preposterously low, being about twelve dollars for 4,500 miles.

At frequent intervals hospitals, barracks, and dining stations are erected, where medical attendance is given free, where children and sick persons are fed without charge and all others can purchase food at cost. Wherever they go, the fostering care of the government follows them. Loans of money and seed are made to the needy and deserving and government stores supply agricultural implements on the installment plan. Is it any wonder that Siberia is rapidly filling up with a strong, sturdy, vigorous population of independent Russian farmers, and that the brutish and cruel Cossack, who is regarded there somewhat as the Sioux Indian is on our own frontier, must look for other fields where his peculiar skill in fighting, plundering, and vodka drinking can be displayed?

A Business Corner in Stretensk

There is little doubt but that the Russian Empire will ultimately expend upon this stupendous enterprise at least $500,000,000, but it is building for the future, and is laying the foundations deep and strong.

REMINISCENCES OF TRAVEL

On the 28th of June, as I bade good-bye to Consul Harris in Nagasaki, he

Church at Stretensk.

said: "I will write a letter tonight and mail it to you at St. Petersburg, by way of San Francisco, New York, and London. I think it will go around the world and get there before you do." And it did, reaching St. Petersburg in 35 days, while it took me 40 days to get to Moscow.

My first stop was in Korea, a poverty-stricken land, which Russia and Japan, in eager rivalry, are attempting to exploit. In my judgment, it will ultimately be a province of Siberia, for islands do not annex continents permanently.

India and Canada do not disprove the rule; for, as we reckon the life of nations, British occupation of either is but temporary.

There is an opinion prevalent that the Philippines are a doorway into China, and that Manila is an *entrepôt* for Chinese trade. One might as well claim that Cuba or the Bahamas could control the commerce of the United States; for, barring the small percentage of Americans and Europeans in Manila, the industry, the enterprise, and indeed the capital is largely Chinese.

From Gensan, in Korea, we crossed the Japan Sea in a splendid subsidized Japanese steamer, with the most cosmopolitan company of passengers that I ever traveled with—a Turkish pasha and wife, two Mohammedan priests and their attendants, and English, Scotch, French, Danes, Japanese, Chinese, Koreans, Indians, Russians, Germans, and Americans.

We arrived in Vladivostok Tuesday evening, July 2. The harbor is a grand one, tremendously fortified from the outer approaches straight into and around the city itself. In many respects it resembles the Golden Gate at San Francisco, the Amur Bay reaching for many miles north and south behind the city.

Vladivostok is what its name implies, "The Capital of the Eastern Dominion," and a wonderful empire that dominion is sure to be. It is totally different from anything that I had seen elsewhere in the Orient. In place of mud huts and nipa-thatched shacks were three and four story brick and stone buildings, and instead of little brown specimens of humanity I found full-bearded, strong-limbed men and vigorous, rosy-cheeked women.

Vladivostok has every appearance of one of our western boomed cities in the very height of its prosperity. An extensive naval station is being established there. Large dry docks for the construction and repair of the fleets of the Pacific are being built. Its wharves were filled with shipping, and everybody seemed to be prosperous and full of business. New hotels, a new railroad station, extensive buildings for a new naval academy, and a college for the study of

Oriental languages are all under construction, and its streets are being regraded and adapted to the city as it will be in the future. The city is built on the southern slope of a high bluff stretching around a branch of the harbor, which is appropriately named the Golden Horn. Good curbs and gutters in the main streets and plank sidewalks throughout the city manifest a proper public spirit, and a most excellent opera which we had the pleasure of attending proved that the esthetic side of life is not neglected. Indeed, as a people, the Russians are passionately fond of music. Few things are more inspiring than to see a Russian regiment march at swinging step to the music of their own songs, and I shall never forget the grand chorus of the evening prayers, in which the crew and passengers daily joined on the River Amur, or the glorious even-song of the choir of monks at the Alexander Monastery at St. Petersburg.

Opera House at Irkutsk

The wearing of a uniform is almost universal in Siberia, in civil as well as military life, and from the common laborer to the governor at least seven tenths of the men wear upon their cap or belt a badge which indicates their occupation, and respect is paid accordingly. Wherever the picture of the Emperor is seen, the cap must be doffed, and always in the presence of an *cikon* the cap removed and the sign of the cross made. The marvelous frequency of both of these objects, indoors as well as out, and the continuous bowing and posturing of the people becomes comical rather than serious to the stranger, and he wonders whether they are as pious and reverential as they seem.

I presume the governor in Vladivostok outranked the postmaster, but his epaulets were not so large nor his uniform so gorgeous. My first purchase in Siberia was a postage stamp, and living in a country where officials are public servants, and where postmasters take off their hats to the people, it seemed strange to me to stand with hat removed before a counter, behind which a man sat with his cap on, dressed like a major-general, and graciously consented to sell me one five-cent stamp, and I was then permitted to withdraw and recover when at the door.

But great as the postmaster is, he is nothing compared to the army officer. On one extremely hot day on the Amur a wealthy merchant was lying on a sofa in the cabin. He had removed his coat in order that he might enjoy a comfortable nap. A lieutenant in the army, traveling third-class as a deck passenger, happened to go by the door, and seeing him in his shirt sleeves, and just above his head a picture of the Emperor hanging on the wall, awoke him and ordered him to put on his coat in the presence of the Emperor. The man objected, and appealed to the captain of the steamboat, but to no effect, for the captain decided that the order must be obeyed, although he admitted it was arbitrary and absurd.

There are times when a despotic government is a good thing, if you are "*it*," but one needs to be "*on the inside*" to enjoy it. When our passports were viséd at Tokio by the Russian ambassador, he sent back with them personal letters to each of the governors of the provinces through which we were to pass. On presenting the letter to General Tchitagoff, at Vladivostok, he at once told us that he would telegraph to Khabarovsk and have our rooms at the hotel and state-room on the steamer reserved, and also have the chief of police assist us while there.

Museum at Irkutsk

The traffic on the Amur under any conditions is enormous, but with navigation almost suspended by reason of very low water, both Stretensk and Khabarovsk had been crowded for weeks by passengers waiting to go up or down the river. We were told by others who had engaged rooms weeks ahead that no first-class accommodations could be secured, but we went on in faith and hope, and when the train stopped at Khabarovsk an inspector of the police met us, engaged our *hisvorshiks* or cabs, looked out for our baggage, escorted us to the best hotel, where excellent rooms had been secured, and advised us that a good state-room was reserved on the steamer for the next day. On the following day he came to the hotel, again cared for our baggage, escorted us to the boat and put us in a first-class state-room, and the gentleman who had so kindly advised us not to go went second-class. A call on General Grodekoff, at Khabarovsk, and presentation of our letter to him, secured the same attention, so that when we arrived at Blagovestchensk, at 11 o'clock at night and two days behind time, an inspector was there waiting for us at the wharf, our carriage was secured, and we were sent to the Grand Hotel, where excellent rooms had been engaged.

RUSSIAN COOKING

We had learned at Nagasaki that travelers through Russia must carry their bed-clothing with them, and had provided ourselves there with pillows, pillow cases, sheets, and blankets; but the hotel at Vladivostok and the dining car on the railroad to Khabarovsk thoroughly convinced us that Russian cooking did not appeal to Yankee appetites. The Siberians are good feeders and stiff drinkers, but vodka, which is principally alcohol, and quass, which is a red beer distilled from rye bread, and strong tea served five times a day and taken by the tumblerful as freely as water, were none of them any use to me. For food, cabbage soup, flavored with onions and garnished with sour milk, was the principal dish, and, with black bread, was invariably served at noon and night. To one who neither ate nor drank any of these things the prospect did not appear hopeful or joyous; but we had been told of a Yankee from Maine who was the only man in Khabarovsk that could speak English, and, as good luck would have it, he was the manager of a large department store. There we outfitted for the campaign and laid in supplies of crackers, jams, and mineral water to last us through to Blagovestchensk, as we supposed.

Mohammedan Tatars at Taiga Railway Station Awaiting the Arrival of a Turkish Delegation

When our steamer, the *Cæsarewitch*, started, she had two large steel freight barges in tow. The first night one ran into the bank. The second one ran into the first, and its back was broken. It was abandoned, and on we went. The river is admirably lighted and buoyed, and great sums have been spent on its improvement; but, like the Mississippi, it is uncontrollable, having one channel today and another tomorrow. There was not a day when we did not run aground. We were due in Blagovestchensk in five days, and were provisioned for that time. On the fifth day meat and white bread gave out, and it meant cabbage soup or nothing. On the sixth day our boat, which drew four feet of water, stuck fast on a three-foot bar, and late in the day we transferred to a twenty-two-inch-draught, stern-wheel-working boat which had been sent to our assistance, and, taking off

A Business Corner in the Heart of Siberia all of the passengers it could carry, proceeded to Blagovestchensk.

"BENEVOLENT ASSIMILATION"

The city is on the north bank of the river. Just below and on the south bank *was* the Chinese city of Aigun. Two years ago it had twenty thousand population and there were three thousand Chinese in Blagovestchensk. When the Boxer troubles began and the railroad down into Manchuria was destroyed, the order came to General Gripsky to "fling the Chinese across the Amur." He tried it, but as the river is more than a mile wide there, it was impossible, and most of them never reached the other side. But the Cossacks went across, and today all that is left of Aigun could be put in a freight car. Not a house is standing, not a Chinaman remains. The gold mines up and down the river, all on the Manchurian side, are being worked by Russian soldiers. *All's quiet in Manchuria*, but a Russian gentleman told me that at Aigun alone ten thousand Chinese found a watery grave, and that the Cossacks on the Amur had been drinking vodka and living on the plunder from Manchuria ever since. That Manchuria has ceased to be Chinese and is thoroughly Russian now, there is no question whatever, and though the methods employed were awful, the results will in the end be better for Manchuria and the world, for Russian occupation certainly means progress.

A European-Russian Village

LOW-WATER NAVIGATION

At Blagovestchensk we called on General Gripsky and were informed that as the water was still falling and the regular boats were unable to run, he had decided to send on the small working boat with the mails, and that we were welcome to such accommodations as there were upon it. He said we would have trouble, but that there was a possibility that we might get through. The alternative was to wait at Blagovestchensk until the water rose. After much consideration we decided to purchase our tickets and go forward, and the experiences of the following thirteen days will never be forgotten.

With no accommodations whatever for carrying passengers, the boat was so horribly overcrowded that there was hardly standing room, and at night both decks were an indistinguishable mass of heads and legs and arms. As first-class passengers, by courtesy we occupied the dining-room, a room about 10 by 12, just large enough for a table and seats on each side. A French captain slept on the table, the correspondent of the Paris *Morning Journal* slept under it, and my friend and I occupied the cushioned benches on either side. When we left Blagovestchensk we were told that Senator Beveridge was a short distance up the river, and that we would pass his steamer the next day. We did pass it five days later, hard aground, but it was half a mile away from us, and we did not see him. Twice we ran on rocks and stove in the forward and after compartments. Supplies gave out, and cabbage soup and sour milk became a luxury. As we dragged our way along we found the Cossack towns had been foraged by the passengers on the stranded boats; but our captain bought two young cattle and killed them on the bank, and with potatoes from the fields and black bread bought from the peasants and wild strawberries for sauce, we came through alive, and reached Stretensk in thirteen days. We had made 1,442 miles in nineteen days. I can imagine that a trip across Siberia from west to east with high water in the Amur might be a pleasant one, but I cannot recommend the navigation of the river against the current in July or August.

INFORMATION FOR FUTURE TRAVELERS

On the Pacific division of the railway, 478 miles, the speed was 16 miles an hour, including stops. From Stretensk to Irkutsk, 747 miles, it was 12 miles an hour, but this includes the crossing of Lake Baikal and long delays at the custom-house. From Irkutsk to Moscow, a distance of 3,463 miles, the average speed was 18½ miles an hour, including stops. On this portion of the journey we took the French *train de luxe* and paid extra charges for "express speed," $6.48, and for use of car and bed-clothing, which is furnished on that train, $9.78.

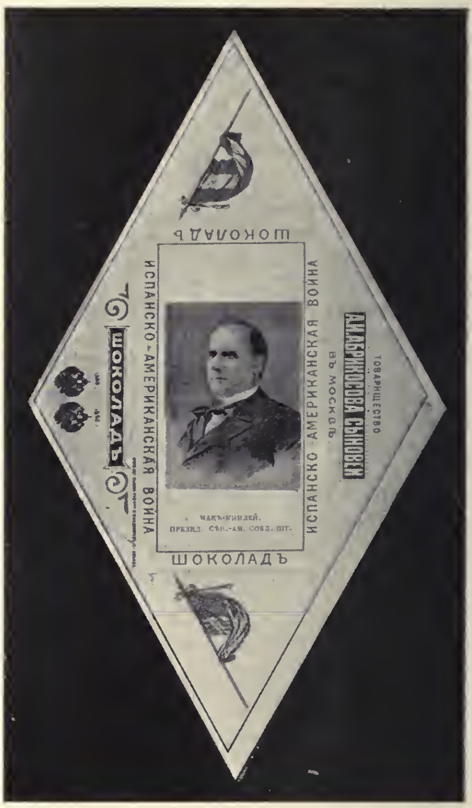
The total time between Vladivostok and Moscow was thirty-eight days. I have recently received a letter from Mr. Penrose, of Philadelphia, in which he stated that he had made the Amur trip eastward the latter part of August, with high water, in eight days, against our nineteen, and that the whole journey was a most interesting and enjoyable one.

The Trans-Siberian Railroad is well constructed—in my judgment, much better than our transcontinental lines originally were. The rails are fifty-four pounds to the yard, and must ultimately be replaced by heavier ones. More than fourteen hundred wooden bridges are being changed as rapidly as possible to steel. The road-bed is well drained, and watchmen flag all trains its entire length. The cars, though built on the English plan of compartments, are equipped with vestibules and Westinghouse air-brakes, and are in every way as comfortable as ours.

A Siberian Village

The dining-car service compares as favorably with ours as the ordinary European hotel does with the American—no better and no worse.*

The trip is an exceedingly interesting and instructive one, and, so far as the railroad is concerned, can be made with entire comfort. With the Manchurian division open for traffic in another year, the "*round-the-world*" travel is sure to go that way, for climatic advantages, together with the saving of time and money, will give it undoubted preference over any other. At present a knowledge of the Russian or German language or the employment of an interpreter is almost necessary, but English is being spoken more and more, and will soon be the commercial language of the world. Indeed, the clerk at the leading hotel in Moscow told me that the great increase of American and English travel through Russia this year had compelled him either to learn the language or give up his place.


ШОКОЛАДЪ
ИСПАНСКО-АМЕРИКАНСКАЯ ВОЙНА
ШОКОЛАДЪ
ТОВАРИЩЕСТВО
А.И. АБРИКОСОВА СЫНОВЕЙ
ВЪ МОСКВѢ
ИСПАНСКО-АМЕРИКАНСКАЯ ВОЙНА
МАКЪ-КИНЛЕЙ,
ПРЕЗИД. СѢВ.-АМ. СОЕД. ШТ.
ШОКОЛАДЪ

A Picture of a Chocolate Wrapper Found in a Peasant's Hut in the Heart of Siberia

The chocolate was made by a Russian firm. The use of President McKinley's picture and of the American flag to make the candy popular among themselves, illustrates the affection which the people of Siberia feel for William McKinley and the American people.

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* For the benefit of prospective tourists I give the items of expense between Vladivostok and Moscow :

	R. K.
Hotel Vladivostok, one day..........	8.57
Fare, Vladivostok to Khabarovsk, 478 miles..........................	17.05
Meals, Vladivostok to Khabarovsk, on train........................	4.00
Hotel at Khabarovsk, one day.......	9.80
Steamer fare to Blagovestchensk, say 500 miles.......................	24.00
Board on steamer to Blagovestchensk.	19.15
Extra baggage..	1.68
Steamer fare to Stretensk, say 942 miles............................	30.00
Board to Stretensk............	31.00
Hotel at Stretensk, one day.........	4.58
Railroad fare to Irkutsk, 747 miles...	24.40
Extra baggage........	5.40
Railroad fare to Moscow, 3,463 miles.	63.50
Express speed ticket................	12.60
Sleeping-car charges................	18.90
Hotel at Irkutsk, three days	15.65
Extra baggage, Irkutsk to Moscow..	16.13
	306.41
Equals United States money.....	$157.80
Meals, Irkutsk to Moscow, estimated.	$25.00
Extra food on whole trip, with mineral water, and bed-clothing, estimated.	38.00
Tips, fees, etc , as you please........	00.00
Total 6,130 miles first-class, including hotels..............	$220.80

Fare alone *on train*, including sleeping-car, but no meals, including baggage for 4,688 miles, $81.34—1.74 cents per mile.

OUTLOOK IN THE ORIENT FOR AMERICAN TRADE

No American in making this trip can fail to be impressed with the wonderful possibilities of Siberia in its agricultural and mineral wealth, and, because of this, the splendid opening which it affords for the sale of American farming and mining machinery. Russians are farmers, not manufacturers, and, poor as the peasants are, one family in that climate will consume more of the world's manufactured products than a score of people of like occupations in the Philippines, India, or anywhere in the tropics, and I think I might truthfully add in China, Korea, or Japan.

The well-to-do Russians are lavish in their expenditure, fond of display, and extravagant in the gratification of their appetites and inclinations. They hold a genuine regard for our country and our people, and it is not a new development. When some of the nations of Europe threatened to combine against us in the Civil War, the Russian fleet sailed into the harbor of New York and her shotted guns silently, but effectively, proclaimed her sympathy. Later she transferred her possessions on this continent to us, and in the sale of Alaska for $7,200,000 put us into the greatest and most profitable real-estate transaction of modern times. Her climate, her soil, her geographical position on the world's map is like our own. Before we gave four million slaves their freedom and left them destitute, to fight their way in life, she emancipated twenty million serfs and is slowly but effectively providing them with homes.

No Monroe Doctrine disturbs our mutual relations or ever can, for her policy is as ours should be, to mind one's own business and say hands off to those nations which make war on other lands for trade expansion only.

She does not pretend to love us because she needs our help, for she has one hundred and forty million people and a land that is unconquerable, and even the Nihilist or revolutionist there is proud of it and would give his life with equal readiness either to better his home conditions or to defend his country from a foreign foe. Her government is despotic, I admit, but self-government is not a remedy for all ills. The world is moving on, and, if I am not mistaken, Russia will be no laggard in the race, for no abler man today controls the destiny of any people than Mr. De Witte, the Prime Minister at St. Petersburg.

We have not got to *make* a market there; it is already made. The Russian railroads are operated with American air brakes, steel barges and steamers from Pittsburg navigate the Amur, and American locomotives are waking Manchuria to new life. On the steamer which brought me to Vladivostok there were seven hundred tons of American farm implements destined for Siberia.

From Seattle and San Francisco to Vladivostok and Port Arthur we jointly own the right of way and can hold it against the world, and the distance across the Pacific is less than from the ports of any European rival.

We need have no anxiety about the trade of China. In due time it will be ours, if we can meet the competition of the world, no matter who controls the government or holds spheres of influence there.

England, France, and Germany are not exploiting China for our benefit, and the trade of Indian and Chinese ports, though nominally open to the world, has somehow been controlled by the dominating power.

In 1900 we sold to China and Hongkong $20,459,385 worth; Great Britain sold to China and Hongkong $41,806,033 worth, or twice as much as we did.

In 1900 we sold to British India and Ceylon $5,227,032 worth, while Great Britain sold to British India and Ceylon

$160,035,563 worth, or thirty-two times as much as we did.

During the same year we sold to Siberia $2,786,664 worth.

In other words, in 1900 we sold to 8,000,000 Russians in Siberia more than half as much as we sold to 300,000,000 people under British rule in India.

In other words, where India purchased American products to the amount of 1⅔ cents per capita, Siberia purchased 35 cents per capita. If this was the situation last year, what will it be in the years to come, with India dormant or dying and Siberia just stepping out into new national life.

The situation in Japan shows what the United States can do in the Far East in competition with other nations under equal conditions.

In 1890 Great Britain sold Japan merchandise to the amount of 26,619,102 yen; the United States sold 6,874,531 yen; Germany, 6,856,955 yen.

In 1900 the respective sales to Japan were: United Kingdom, 71,633,219 yen; United States, 62,761,196 yen; Germany, 29,199,605 yen.

Our exports to Asiatic Russia have been as follows for ten years past:

1891	$161,580
1892	120,200
1893	145,591
1894	163,855
1895	204,937
1896	568,002
1897	413,942
1898	618,015
1899	1,543,126
1900	3,050,102
1901, 10 months	779,839

or, on the basis of a year, $909,812, or a loss in a single year of more than two million dollars, or two-thirds of our entire trade there since the sugar-bounty decision was made by the board of appraisers in New York.

Our trade conditions in India should be a warning to us in dealing with the Chinese question.

Hon. George Curzon, in his "Problems of the Far East," says "that the commercial supremacy of Great Britain in the Far Eastern seas, though sharply assailed by an ever-increasing competition, has not as yet been seriously shaken. How vital is its maintenance, not merely for the sake of our empire, but for the sustenance of our people, no arguments are needed to prove. It is only in the East, and especially in the Far East, that we may still hope to keep and create open markets for British manufactures. Every port, every town, and every village that passes into French or Russian hands is an outlet lost to Manchester, Bradford, or Bombay."

Every word of this is literally and absolutely true. It is for themselves and not for us that European nations seek concessions and mark out spheres of influence. Each one pursues its own peculiar method, but the result is alike in all.

There is no sphere of influence for us there, and to look upon Manila as a base for Chinese trade is like chasing rainbows for a pot of gold, for commercial bases are not established six hundred miles at sea and where storage and reshipment charges would be more than the direct freight to the destined market. The integrity of China cannot be preserved by a protectorate of the Powers, and if it could the people of this country would not permit our government to be a partner in it. China must reform herself or go to pieces speedily.

My judgment is that her destiny is slow but sure absorption by Asiatic Russia, and that the world will be the gainer by the change.

Meanwhile our duty and our interest is to keep on terms of peace and amity with all, but to make alliances with none.

THE TEACHING OF GEOGRAPHY

By Ralph S. Tarr, Professor of Physical Geography in Cornell University

GEOGRAPHY has an important position as a fundamental branch of instruction in the schools. The length of time devoted to it would lead us to expect from it highly important results in mental discipline. Yet one is frequently hearing the statement made that geography instruction is woefully barren of educational results. This does not mean, of course, that there are not individuals who are securing the best results from geography work, but that, as a whole, the ends obtained are not of the kind that should be expected. There are evidently difficulties in the way of making geography work in the grades as successful in its results as it is certainly capable of being made. That the teachers are alive to this fact is evidenced by the numerous text-books that are appearing and by the activity of educational associations, which in almost every meeting discuss some phase of the problem of how to secure good results from geography instruction.

This activity of the teachers is a most hopeful sign; for "where there's a will there's a way." That it has accomplished results is evident to all who have given attention to the subject. The methods of teaching today are so far different from those of a quarter of a century ago that those of us who spent our time in memorizing lists of all the capes of eastern America, all the capitals of the states, etc., would scarcely recognize as the same subject geography taught in a modern class-room. There is surely progress; but much remains to be done.

NEED OF TEACHERS WITH BETTER TRAINING

In answering the question, "What is to be done?" I should say, first of all, have better teachers. That this statement may not be misunderstood, let me hasten to add that it is in no sense intended as a criticism of the teachers. As a body they are overworked and underpaid. They are trained to one line of teaching, and then, by the caprice of the superintendent, perhaps, given some new method—often a fad—of which so many pass over the educational world. They do their best, work hard—far harder in fact than they ought to be expected to work—and, in spite of tremendous difficulties, accomplish better results than can properly be expected of them, though less than the subject itself is capable of furnishing. The difficulty lies beyond the control of the teachers under existing circumstances, and its correction can come only very slowly. It is a consideration of this problem that I would, first of all, take up.

The teacher in the grades has as her primary work instruction in reading, writing, arithmetic, and *geography*. A training that will adapt a person thoroughly for the task of teaching the first three may fall far short of fitting her for a geography teacher; for to teach geography well requires knowledge, not necessarily profound, but nevertheless fairly thorough, upon a large range of topics. One must know enough geology to understand the physiography; enough physics to grasp the meaning of climatic differences; enough history to appreciate the influence of history upon political geography, etc. In other words, geography has such varied relationships that the teacher who would teach it properly must have a broad range of information. Otherwise it is necessary to blindly follow the text-book, and this, unfortunately, is far too often done.

Then, too, the teacher must be well-balanced—not too easily led astray by passing fads which often appear so attractive. This presupposes sufficient appreciation of the subject and its possibilities to understand what is good and what is bad in method. Next to *knowing* something to teach, it is important to understand *how* to teach what one knows—what to include, what to omit, how to present difficult points, and how to secure training from the teaching—not merely of the memory, but of the powers of observation and deduction. I believe that I am not misstating the facts when I say that, while geography demands these powers from the teacher, it is possible to teach the other three subjects with much less training. Instead, therefore, of demanding from the teacher the knowledge and training which geography requires, a teacher is selected who is amply qualified for the other subjects, and then required to do the best she can with the difficult and complex subject of geography.

OPPORTUNITY FOR SECURING TRAINING

To secure better trained teachers, boards of education should be prepared to offer better compensation. Three or four hundred dollars is now commonly offered, and this surely cannot command highly trained teachers of geography.

Not only is it difficult to find well-prepared geography teachers because of the complexity of the subject and of the low compensation offered, but also because of the limited opportunity for securing proper training for such teaching. By far the greater number of grade teachers go no farther for their training than the high school, with possibly a year of two in a "training class" or as pupil teacher. No geography instruction is given them in the high school, and little that bears directly on geography, with the exception of some short courses in geology, physical geography, etc., which are often indifferently taught, and rarely so taught as to show their geographic significance. Thus the teacher of geography is, in a vast number of cases, selected from the ranks of those who had no further instruction in geography than that of the grammar school. In other words, the teacher must return to teach the subject with little more knowledge of it than the very pupils whom she teaches will possess when they go from under her instruction. It is not quite as bad as this, of course, for the teacher is more mature, better disciplined mentally, and, in the natural course of events, has obtained a broader range of information. But it is an anomalous condition, and, in view of the fact that so many teachers are supplied from the high school, there seems to be a demand that geography instruction be given in that school. There are other good reasons for believing that geography should be taught in the high school, but as these have no bearing on the present question they will not be considered.

Of the teachers who did not get their preparation solely from the home schools the great majority come from the normal school. The training there is decidedly better, and in some is excellent; but in far too many it is very far below the standard that should be set. I have visited one normal school (and understand that there are many quite like it) where the geography was taught by the teacher of English, while the science was all in the hands of one man, who, in spite of his marked ability, was unable to do good work with any science, because he had to give short courses in nearly all — physics, chemistry, zoölogy, botany, geology, physical geography, and physiology. At the time of my visit he had just had his burden increased by the requirement to teach temperance physiology. Much attention is given in all normal schools to "method," and in many of them the students are given instruction in method without a knowledge of the subject in which the method is to be employed. The best preparation for method of teaching is a knowledge of the subject to be taught, and without that knowledge drill in method cannot produce much result. But one of the most hopeful features in the movement for better teaching of geography is the improvement of the last ten years in the normal schools. Those that are abreast of the times have provided special teachers of geography, and in many cases have provided trained geographers. Each year the list of such schools is increasing, and the effect of this advance must be felt in a decided improvement in the teaching of geography in the grades.

The gist of what I have said above is that the conditions of geography teaching are bad, but are improving in various directions. But the complexity of the subject, and the lack of facility for obtaining proper training in it, make it certain that for many years to come the teaching of geography will not be raised to the desired high standard unless there are several fundamental changes, of which the most important must be to provide for better training, to require it of applicants, and to pay them in proportion to the training demanded. Such changes can come only slowly; but in the meantime there are some simple reforms which, if introduced, would cause a very decided improvement in a very short time.

In the first place, the teachers of geography should be encouraged (or, better still, required) to put part of their summer in further study and preparation. The summer schools of many universities offer opportunity for such study in geography, or in allied subjects upon which much in geography is based. To encourage such attempts at improvement increases in salary should be given to those who show sufficient zeal and intelligence to put part of their summer in study. This method is already followed by some of our large cities and with most excellent results. It should be extended. A modification of this is to offer to some of the best teachers a sort of scholarship to pay the expenses of a summer, or even an academic year, at a university. Few investments of school money could be better made with promise of more far-reaching results. This method is followed in Indianapolis, where the funds were provided by a wealthy citizen. It is a unique form of bequest; but how could money be better used than to provide for an uplifting of the teacher who gives to children their early training, upon which so much of their future depends? Would that every city in the land had a Gregg fund similar to that in Indianapolis.

THE UTILIZATION OF SPECIALLY TRAINED TEACHERS

Improvement will come also when the school authorities recognize the fact that geography is a difficult and complex subject, requiring knowledge of a broad kind, and, for proper instruction, a talent in addition to mere knowledge. In every city there are some teachers who really know geography, who like it, and whose work is eminently successful; but these teachers are required to give most of their time to other subjects than geography. Why not make use of these special talents? Why not have specialization in the grades as in other schools. There are special drawing teachers and music teachers because not all teachers can draw or sing. It is equally true that not all teachers can give instruction in geography; and while a teacher may be an excellent instructor in arithmetic, reading, and grammar, she may be a flat failure in geography. Let the school boards but recognize this fact and take for geography work those who are best qualified for it, and there would be an immediate advance in result that would be most gratifying, and that would lead toward constant improvement. I think no other reform in school work is now so seriously demanded as this simple one. There is no reason why the geography teacher should not handle the geography in every grade; in fact, there is every reason for believing that it would be better to have it done so than to have the children go from one type of teacher to another—good, bad, and indifferent. It would, to be sure, call for some rearrangement and reorganization, but nothing serious. Once this was started, the grade of geography teacher would improve, both by the necessity of specialization and by reason of the fact that, when a new teacher of geography was to be selected, inquiry would be made concerning her special fitness for that work—an inquiry not now commonly made.

Another improvement of almost equal importance to the one last proposed, though less feasible than that, because of the additional expense involved, is to have a geography specialist as supervisor in every city. I know of a man who is a specialist in geography, thoroughly competent to guide work of the best kind, who is teaching all the English, and nothing more, in the high school of the city, not because he prefers it, but because that was all that was open to him there. What an advantage it would be to that city if he were employed to guide and instruct the teachers, to outline a rational course, and to see that uniformly good work was done! Many cities have teachers competent to fill such a position, and the additional expense ought not to be considered when such important results are to be secured. It has often been found possible to provide for nature-study teachers. Why not also geography supervisors? If some of the educational conferences would turn their attention toward such practical needs as these, instead of devoting their time to pedagogical discussion, there would be more good accomplished, more speedy improvement in teaching, and less valuable time wasted.

NEED OF UNIVERSITY COURSES IN GEOGRAPHY

One more important change seems to me to be called for. In the United States there are now 10,000,000 children, more or less, being taught geography, and approximately 400,000 teachers engaged in teaching them. These teachers should receive better instruction. But where are they to turn? To the normal school? Then where is the normal school to turn for its teachers? Where, in this country, is an education in geography to be obtained? While there are institutions in which physical geography is well taught, or the pedagogy of geography, or commercial geography, there is not a single institution in America in which provision is made for adequate and well-rounded training in geography. It follows, then, that the would-be teacher of geography must either go abroad or else himself fill in the gaps in his training, after having obtained what he can from some institution in which a part of geography is taught.

Is it not an anomalous condition in our educational system that one of the oldest and most respected branches of learning, in which all our youth are instructed by tens of thousands of teachers, in a course covering at least five years of their lives, finds no place in our universities? One by one new sciences have developed and found their way into the university curriculum; but the English-speaking people provide no place for the venerable geography, notwithstanding the fact that so much of their development has depended upon geographic knowledge. It is not because there is lack of interest in geography, for there are enough who are interested to form numerous societies with great influence. Our geographic magazines rank with the best scientific periodicals, which indicates that men are not merely members of the societies, but also workers in geography.

Doubtless investigation would reveal reasons why geography has been ruled out of the university while many really less important subjects have crept in; but no investigation can offer adequate reason why this condition should be allowed to continue. We need such instruction for many reasons; but, confining ourselves to the single purpose of this paper, we need it for the sake of the advancement of geographic instruction in the schools. There is an ever increasing demand for training in geography, for which no adequate provision is made. If only one of our large universities could set the example of establishing a *school of geography*, others would soon find it necessary to follow. Such a school should provide instruction in the various branches of geography and in the pedagogical aspect of the subject as well. It is quite useless to hope to see such a school established by the university, for the simple reason that every university has such demands upon its resources that a large, new department could not be provided unless it were absolutely necessary. For the establishment of such a school money must be specially provided. Is there not some one among the many who are interested in geography who will see the need of a school of geography and provide for its establishment? The founding of such a school will mark the beginning of a new era in the teaching of geography, as well as in other lines of geographical work.

NEED OF A PLAN FOR GEOGRAPHY STUDY IN THE SCHOOLS

While, according to my view, improvement in the treaching staff of the grades is the greatest present need of the schools, and has therefore been given first place in this article, I consider it highly important also that there should be some agreement as to *what* should be taught and *how* the subject-matter should be presented. By this I of course do not mean that there should be absolute uniformity, for there must always be much difference in detail, according to the individual and to the environment; but that there is a general feeling that something like a rational plan should be agreed upon and followed is indicated by the fact that the matter is every now and then made the subject of committee report and discussion at leading educational conferences. The diversity of the reports presented proves how difficult it is to find a plan acceptable to all, and the marked differences in the leading text-books points to the same conclusion.

This question is altogether too large a one for full discussion within the limits of a single short paper, and accordingly I shall confine myself to a mere statement of a few fundamental principles which I believe should govern all courses in geography in the grades.

There should be a well-matured plan so that the course should develop step by step—that is to say, the earlier lessons should form a foundation on which the later ones may be built. Unfortunately in many cases there seems to be no such provision, but instead, topic after topic is introduced with no previous foundation and no vital relationship between what precedes or follows. It is a mass of description and unrelated fact. For example, the trade winds are described as parts of physical geography, and later, when their influence on rainfall or desert might be shown to explain striking features of geography, there is no such application made, and the pupil is allowed to go away with the knowledge of two sets of facts without any hint as to their connection. Glacial deposits are described, but little or no use of them is made in explaining industrial development in glaciated regions, etc.

THE ELEMENT OF INTEREST

The well-matured plan proposed should provide for the element of *interest*. By this it is not meant to make the course easy, nor to go outside for material just because it is interesting. There seems to be a feeling in some quarters that it is undignified and undesirable to provide for interest; but there could be no greater mistake than this. Where interest is not aroused, work becomes tedious, the mind readily tires of the task, and soon such a dislike for the subject is created that nothing is done except that which is required, and even this is done with little result. It was only yesterday that a young girl said to me, "I hate geography. I passed the regents' examination in it and now I am going to forget it just as fast as I can." This view is far too common, and it is not the child who is to blame for it; nor is it geography, but the method of teaching, which has failed in the fundamentally important point of arousing and maintaining interest.

Some try to provide interest by reading to the class, or by telling stories of school children in other lands, or of cannibal feasts, etc. The *attempt* is laudable, but the *method* is trivial and totally unnecessary. Interest can be provided without departing one step from a well-defined plan of scientific presentation, as I shall attempt to point out below. Once interest is aroused, the amount of work which it is possible to expect from the children increases many fold. It is the same as in more mature men, who, when interested in their life work, are able to work hard and with effect, while if not interested, their life is very apt to be a partial or complete failure. If the geography student has an interest in his work he will not merely learn his lessons well and remember what he has learned, but he will also be eager to learn more by reading and inquiry. These facts seem to me so evident that I would hesitate to dwell upon them so long if it were not that, strangely enough, there are those who do not seem to grasp the point.

Let me insist that the arousing of interest does not mean that the work be made easy. It *becomes* easy because of the interest; but with interest the child is even ready to learn the list of all the capes of Asia if the teacher sets it as a task. Memorizing, observation, reasoning, inquiry—all these are stimulated by the interest; and the benefits derived from the study, instead of being lessened by reason of interest, are greatly increased by it.

IMPORTANCE OF HOME GEOGRAPHY

In order to present the subject in such a way as to provide for a connection between topics and for the development of interest, and its maintenance, it seems to me that it is necessary to follow only a few very simple principles, provided, of course, the "teacher" is a *real* teacher. In the first place, there should be a proper foundation. To jump right into the wide world with children of eight or nine years is perfectly absurd, even if the teacher or geography writer may say, "Now, dear children, we will go over hill and mountain and sea to see what other dear children are doing," etc. They simply are not ready for such a journey, even though it is taken in baby talk. Much of it is absolutely meaningless to them, because they lack experience; and before they can take it they must have a foundation. Next to the need of better teachers I should place the need of *a better basis upon which to study distant geography*. They must really know the meaning of mountain, valley, river, ocean, commerce, etc.; and they must understand what maps stand for before they can study intelligently about the Atlantic Ocean, Mississippi River, and Alps, and before they can understand why London is a great city and be able to locate it on the map and know what such a location really means.

Too much care and attention cannot be given to the building of this foundation. It is difficult to treat in a general way, and is therefore absent or poorly presented in almost all the text-books. It can be secured only by a study of the conditions surrounding the school and the intelligent use of the knowledge thus gained in application to more remote regions and conditions. Thus it is necessarily dependent upon environment; and what in detail is adapted to one environment is perhaps not available in another. Therefore only general rules can be laid down, and this is not the place for them; but that *home geography* should serve as the foundation for future geography study is absolutely certain. Yet how rarely it is done! In a city of 15,000 a few years ago I found a teacher giving a lesson on the Mississippi delta. I asked if any in the class had ever seen a delta, and no one had—not even the teacher. Yet the school was on a delta two miles long and half a mile wide. How much more the Mississippi delta would mean if these children had understood their own! And the same thing holds for quantities of other features. There is no school in the country that has not scores of geographic features available for use in building a foundation for geography study.

Nor does the study of the home surroundings merely serve in giving a preparation for future study; it also arouses interest. Geography is no longer a mere study of distant lands, for the home of the child is a part of it. The winds, rains, soils, rivers, railways, etc., are bound up in intimate connection with world phenomena. The pupil's home is but a part of a whole; and when he studies the whole he is constantly seeing its relation to the part which he knows so well.

There is so much of value to be gained from long and thorough study of the home, and from frequent use of these facts in later study, that I should like to see a full year, or even two, devoted to it; and when this is done provision should be made for frequent excursions, as the Swiss so effectively do. Will teachers and superintendents in America ever realize that a half day spent by the river or in the factory may be made of more educational value than tenfold as much time in the class-room? The nature-study idea is a move in the right direction; but it seems to me that far more good would come of it, and far more opportunity for its extension would be found, if it were *geographic nature study*—that is, study that not merely creates interest in surroundings, but in that particular class of surroundings which have a broad application to something. The same powers of observation could be developed and the same interest aroused with, in addition, a larger training in reasoning and an application to life work. Rain or wind offer as good an opportunity for nature study as a tree bud; a lake or stream as a tadpole; and the soil as a caterpillar. Zoölogists and botanists have developed nature study. Is there not some one ready and competent to present geographic nature study? It is needed.

THE PHYSIOGRAPHIC BASIS

Having a foundation resting on the appreciation of the home environment, the future study should be related to this, partly to illuminate the subject and partly to maintain the interest. As new topics are presented there should be a *causal sequence;* and this seems to me to be one more fundamentally important principle in geography teaching. Instead of teaching unrelated facts there should always, where possible (and there is nearly always a possibility), be an attempt to show relation between cause and effect. If wheat in the Red River Valley is the topic, the reason why wheat is grown there should be shown; if the size of New York city is stated, it should be shown why it is so large; if the desert of Sahara is being described, there should be a reason apparent; if the marked colonial development of the British Empire is stated, reasons should be presented, etc. Here, again, the method proposed provides for interest and also makes certain a clearer understanding. Facts thus learned will be remembered and memory will not alone be exercised; for if the chain of thought is logical, as it must be if properly presented, a habit of logical thinking will be trained.

In geography there are several bases for a causal sequence, though by far the greater majority of facts which the children learn rest upon either the historical or the physiographic basis. It follows, therefore, that some attention must be given both to history and to physiography, not in either case for their own sake alone, but merely in so far as they are needed to understand the facts which general geography includes. I believe it to be as great a mistake to include too much physiography or meteorology as to include too much history or biology. Pure history or biology are, by common consent, excluded; and pure physiography, which is a branch of geology, should likewise be excluded; but for the purposes of general geography each of these subjects, and as many others as are necessary, may be drawn upon to the full extent that they may be needed to serve as a broad cause for a part of a geographic sequence—that is, in so far as they have a direct bearing on an interpretation of the relation of man to the earth, they may be introduced into general geography.

Of the several bases for causal sequence not one has so much importance as physiography. In the past this aspect has been greatly overlooked. At the present we are perhaps carrying it a little too far—at least many believe so—and for my part I agree with them; but that physiography is fundamentally important to a rational scientific study of geography, in which cause and effect are considered, no one whose opinion is worth hearing can now question. If we wish to understand the position and importance of San Francisco, Chicago, New York, Boston, Montreal, the British Isles, etc., we must know the physiographic facts. The application of physiography is well-nigh universal. Its introduction, therefore, makes the study of geography rational and scientific, and, if not carried too far, it makes the study interesting, because it shows how, from certain causes, important results necessarily follow. If merely introduced and not applied, as it is in some of the texts, it not only loses its value, but it is positively dangerous, because it deadens interest and repels students. A reaction against physiography has already set in among teachers because of this fact.

TEXT-BOOKS IN GEOGRAPHY STUDY

It would easily be possible to follow this subject much further, and to enter into many details not here referred to. But this is not the place for that. Elsewhere, in a series of text-books, I have, in association with another, endeavored to work out in detail a system of geography for the schools, in which the main underlying principles are those set forth above. My final point is that it is by such practical expositions as the preparation of text-books that we are to gain much of our advance in geography instruction. Much time is wasted in committee reports and association discussions of geography courses. These presuppose that teachers can fill in the gaps, which in nine cases out of ten is an unwarranted assumption. Let us have more text-books, each embodying the ideas of its writer. Each good text-book will improve the teaching, partly by its own use and partly by forcing competing publishers to try to equal or excel it. Out of these books in time will come one which approaches the ideal; for each good new book makes it easier to write a better one partly by showing what is weak and partly by reason of the strong points which it contains. We need more geographies and each good one that appears should be welcomed as a step toward attaining better results.

I dwell upon text-books with full knowledge of the fact that there are dreamers who believe the text-book to be bad, who think teachers do not need these helps, and who say that to tell a teacher how to teach, or to give questions and suggestions, is "an insult." The teacher needs all the help she can get; would that it were different, but it is not, and teachers know it and admit it and are doing their best to advance under difficulties. It is better to use the poorest of text-books than to follow the plan of teaching without one, for the latter method leaves many loose ends. It is the introduction of the "college idea" into the grades. It is coming to be believed by many that the lecture system is overdone in colleges where specialists are employed. What a result, then, must be obtained where the hearers are mere children and the teachers by no means specialists! Far better is it to use a text, and then, if the teacher has the ability and knowledge, to add to it where it is weak or where she is strong—that is to say, have a skeleton to build on. There are in every text-book some things said better than most teachers can say them, and these statements are in print, not taken down as notes with a part lost.

If the teacher can find time for extra work, it would be far better to use that time in laboratory work, using this term to include also a study outside of the school-room. Here is a chance to do something that no text can provide and whose results are of exceeding importance. The value of this work as preliminary and basal has already been mentioned when speaking of home geography; but it should be continued throughout the course. I do not speak of it further here, partly because it has already been pointed to with more or less fullness by others on various occasions, and partly because I believe that there are other lines of improvement of more fundamental importance than this, and much more liable to be adopted, because the way to their adoption is already open. Laboratory work means time, equipment, and training not now generally available. It is better to try to get it started where most needed, namely, in the very earliest years; and from this as a nucleus it will spread to the higher grades, when once its value is established there.

SUMMARY

Briefly summarized, the points made in this article are that there is an opportunity for improvement in geography instruction along several lines. First of all, there is need for better training of teachers, and this calls for geography courses in the high schools, better teaching in the normal schools, and provision for training of geographers in the universities; but by making a better use of the talent already available—that is, by having geography supervisors in the cities, and by having the teachers who are best prepared for it take all the geography work, or all the arithmetic, etc., instead of spreading themselves over all subjects, an immediate improvement may take place; for in the grades there are already large numbers of teachers who are well prepared for the position of geography teachers, or who could quickly become so if they were given a chance to specialize. Immediate improvement may also be expected if teachers are encouraged to take advantage of the opportunities open to them in the numerous summer schools.

As to method, there should certainly be teaching in home geography, and this should involve laboratory and out-of-door work. A well-defined plan of instruction, in which home experiences and the physiographic and historic basis are made use of in the development of causal sequence, should also be followed; and through it all there should be no time when the element of interest is not present. For the betterment of geography instruction we need more text-books of good quality, and, as time proceeds, there should be more and more laboratory work provided.

Already much progress has been made and each year shows a greater measure of advance; but there is much still to be desired, and, as I view the problem, the above-mentioned lines are the ones along which there is the greatest present need of improvement. They are all feasible, and none of them call for any very serious change in conditions. Agreement upon them is desirable, and a will to move along these lines would in very short time succeed in revolutionizing geography teaching and in making this instruction effective where now in so many cases it is ineffective, and in some cases even producing evil results through misinstruction.

THE LATEST ROUTE PROPOSED FOR THE ISTHMIAN CANAL—MANDINGO ROUTE

GREAT interest has been aroused during the past few weeks in the new route proposed for the Isthmian canal. If all that the sponsors for the route, the American Isthmus Ship Canal Company, claim and believe should prove to be correct, they have undoubtedly discovered a waterway that eclipses the Panama and Nicaragua routes in every respect.

The new route, called the Mandingo route, is some forty miles south of the Panama Canal. It starts from the Mandingo Bay, in the Gulf of San Blas, tunnels through the Cordillera for about five miles, and then cuts through hard rock, level country for about 20 miles, straight to the Bay of Panama. In certain respects the Mandingo route coincides with the San Blas route, from the Harbor of San Blas to the mouth of the Rio Chepo, on the Pacific, which was advocated several decades ago. It differs, however, from all the so-called Darien routes previously urged in that it makes use of no stream or lake, but is a direct cut from ocean to ocean. There is a deep, protected natural harbor at either end of the line, which is straight as a rod; not a single lock would be required, and the canal, the company state, for the entire distance would be cut in hard rock instead of in mud and sand and swamp. The one engineering problem, a tunnel five miles long, 202 feet high and about 200 feet wide, the company claim competent American engineers and contractors are willing to undertake and construct at such a moderate cost that the entire expense of the canal would be less than by either the Panama or Nicaragua route. Electric lights would make the tunnel bright as day, deep shafts would ventilate it, and an electric trolley pull the vessels back and forth.

The company proposes to build the canal without financial assistance from the United States Government further than a guarantee of its bonds as the work progresses. In return for this guarantee the United States is to have free transit for all warships for 100 years.

The company has not obtained any concession from the Colombian Government, as the Panama concession does not expire until 1910. The matter of a concession is, however, for the present, immaterial. The great question is, which is the best and most enduring route. When the route has been found that possesses the greatest certainty of keeping open at all times and for all time, the matter of a concession can be arranged.

General E. W. Serrell, the consulting engineer of the company, and the man who has planned this Mandingo route, has been a famous engineer for half a century. In 1848 he was assistant engineer to the Panama Survey; in 1850, the chief engineer in the construction of the Niagara bridge; later he was the chief engineer in the construction of the Hoosac tunnel, and he has been associated with many other great public works.

The American Isthmus Ship Canal Company has issued a preliminary statement setting forth their arguments in favor of the Mandingo route. Practically their entire statement is printed below. It is so positive that it deserves most careful consideration. The map that follows the statement is a copy of the map prepared by the company to accompany the statement.

STATEMENT OF AMERICAN ISTHMUS SHIP CANAL COMPANY CONCERNING PROPOSED MANDINGO ROUTE.

"The American Isthmus Ship Canal Company, incorporated under the laws of the State of New Jersey on the 30th day of June, 1899, proposes to construct and operate a tide-water sea-level ship canal across the Isthmus of Darien, in the Mandingo country, a straight line, without locks or tide-gates, 29½ miles long, from a good harbor in the Gulf of San Blas, on the Atlantic side, nearly south, to a good harbor back of the Pearl Islands on the Pacific side.

"Having completed its preliminary work, this company now proposes to show that its enterprise is the ideal canal. . . . It proposes to build and operate the canal itself, under proper supervision, however, of the United States Government.

"It asks no appropriation from the Congress. It seeks to take no dollar from the public funds. It asks that the United States Government shall guarantee its bonds, in principal and interest, as the property acquired and work done under government supervision justifies, and it offers as an equivalent for such guarantee free transit for vessels belonging to the United States through its canal for one hundred years. . . .

"The various proposed lines may be generally classified in two groups—first, sea-level tide-water canals; second, canals depending upon impounded water, with locks and tide-gates.

"The advantages of the former are manifest and scarcely need enumeration, while the disadvantages of the latter, both in construction and operation, are equally beyond discussion. It is only necessary to refer to the successive reports of the commissions of recent years to clearly see this point. To depend upon rain water impounded by dams, in a country where every rain-storm is almost a cloudburst, and is therefore a grave danger to the dam which is expected to contain it, is not desirable. To operate great ships through tortuous channels, to lift them up and down by gigantic locks, would, if inevitable, be a most pitiful solution for 20th century science to give to a problem so long discussed and so vitally important. But, if avoidable, such a choice is not a solution of the problem and leaves it open for a better answer.

"The report of the Isthmian Canal Commission, just submitted, indeed recommends the adoption of the Nicaragua route, but purely as a choice of evils. It admits all that has been said above in regard to the fundamental principles that underlie this discussion. There can be no doubt that the Commission would have welcomed a straight waterway, without locks or tide-gates as the solution of this question, and have eliminated immediately from the discussion any canal with impounded water and locks, if such a line had been before them.

"It will naturally be asked, then, how such a line came to be overlooked, for a route in the San Blas region is not a new thought. That such a line offered the shortest distance between the oceans, that it possessed perfect natural harbors, that it could be made at sea-level, were facts within the knowledge of the Commission, and a reference to their report will show a description of such a line and a discussion of its merits. It will there be seen that the Commission preferred both the Nicaragua and Panama locations, considering the tunnel of San Blas more objectionable than the complicated system of locks and tide-gates, dams and lakes, of Nicaragua and Panama. The Commission, however, made the line they illustrate in valley locations, necessarily involving curves and radically objectionable from our point of view, in a country of violent rainstorms, while their tunnel, both in design and cost, is far inferior to the Mandingo tunnel, which we advocate and which we claim to be the ideal solution of the canal problem.

"It will be asked why the American Isthmus Ship Canal Company did not bring its line to the attention of the Commission.

"The answer is, first, the Commission was appointed to discover and describe a canal route to be owned and operated by the Government of the United States. This was not and is not our purpose.

"Second, and far more important, is the fact that not until the deliberations of the Commission were practically closed had we completely located our straight line and demonstrated to ourselves and to the eminent scientific gentlemen whom we consulted the feasibility and economy of our tunnel plans.

"When this point had been reached we laid the matter before the President of the United States, who referred it to the Commission; whereupon we sought and obtained an interview with Rear Admiral Walker, the president of the Commission, who, together with Professor Burr, expert engineering member of the Commission, saw our plans, maps, and drawings, and desired that they be exhibited to Mr. Morison, who was charged by the Commission with the investigation of the group of projected routes, of which ours is one. Mr. Morison, up to the present time, however, has not found it convenient to call upon us. We are confident that when Mr. Morison shall have seen our plans and communicated with his colleagues the Commission will make a supplementary report to Congress which will clear away any doubt as to the preference due to our canal.

"It must be already apparent, from the facts above stated and from the report of the Commission, that the only point in our plans open to discussion is the tunnel. But does the tunnel really present an objection to modern science and to present mechanical devices, whatever may have been the case at an earlier period of the inquiry? The answer is most emphatically, No.

"By existing appliances, by means of machinery now in the market and in successful operation, this tunnel can be quickly and economically built, and with certainty and safety economically operated. It is a work, says an eminent authority, 'not of difficulty, but of magnitude,' and when it is recollected that its magnitude is insignificant as compared with the engineering work involved in its competitors, it will, we think, be apparent that the tunnel is no real objection to the line.

"We have exhibited our studies for this tunnel to eminent engineers and have received the most flattering indorsement, which will in due time be made public, and we shall show that experienced and responsible contractors are willing to build our canal within our estimates, and to give satisfactory bonds to that effect.

"We are of opinion that, although full faith and credit should be given to the opinions of competent engineers, the cost of an enterprise can never be certainly fixed until responsible contractors have named the price at which they will undertake it.

"The following are the points upon which the Mandingo route depends for your approval:

"*First.* Its length is but 29½ miles.

"*Second.* It is a perfectly straight line from ocean to ocean.

"*Third.* It possesses perfect natural harbors, large enough and deep enough for commerce.

"*Fourth.* It has no locks nor tide-gates nor dams, but is essentially a part of the water system of the world, where shipping can pass without hindrance or delay.

"*Fifth.* It does not depend upon impounded water, with all the contingencies involved in such dependence, but becomes, on the contrary, from the moment of its completion a portion of the ocean.

"*Sixth.* It can be constructed, ready for operation, in not more than three years.

"*Seventh.* Its capacity, under all conditions of tide and weather, allows the passage of 288 ships per day under a headway of one mile.

"*Eighth.* Electric trolleys will propel shipping through the canal with certainty, regularity, and safety.

"*Ninth.* The time of transit for steamships under their own steam in the open cuts and by trolley through the tunnel will be three and a half hours; for ships not using their own motive power the time by trolley towage will be five hours.

"*Tenth.* The distance to and from all South Pacific ports is shorter and the time needed less. To all North Pacific and insular ports the certainty and rapidity of transit will give it a time advantage which more than balances its slight disadvantage in distance.

"*Finally.* The American Isthmus Ship Canal Company asks no money from the Treasury of the United States. It proposes to give to the commerce of the world ideal transit from ocean to ocean at a moderate and just price, and to the Government of the United States in exchange for the guarantee of its bonds free transit for one hundred years for the national ships.

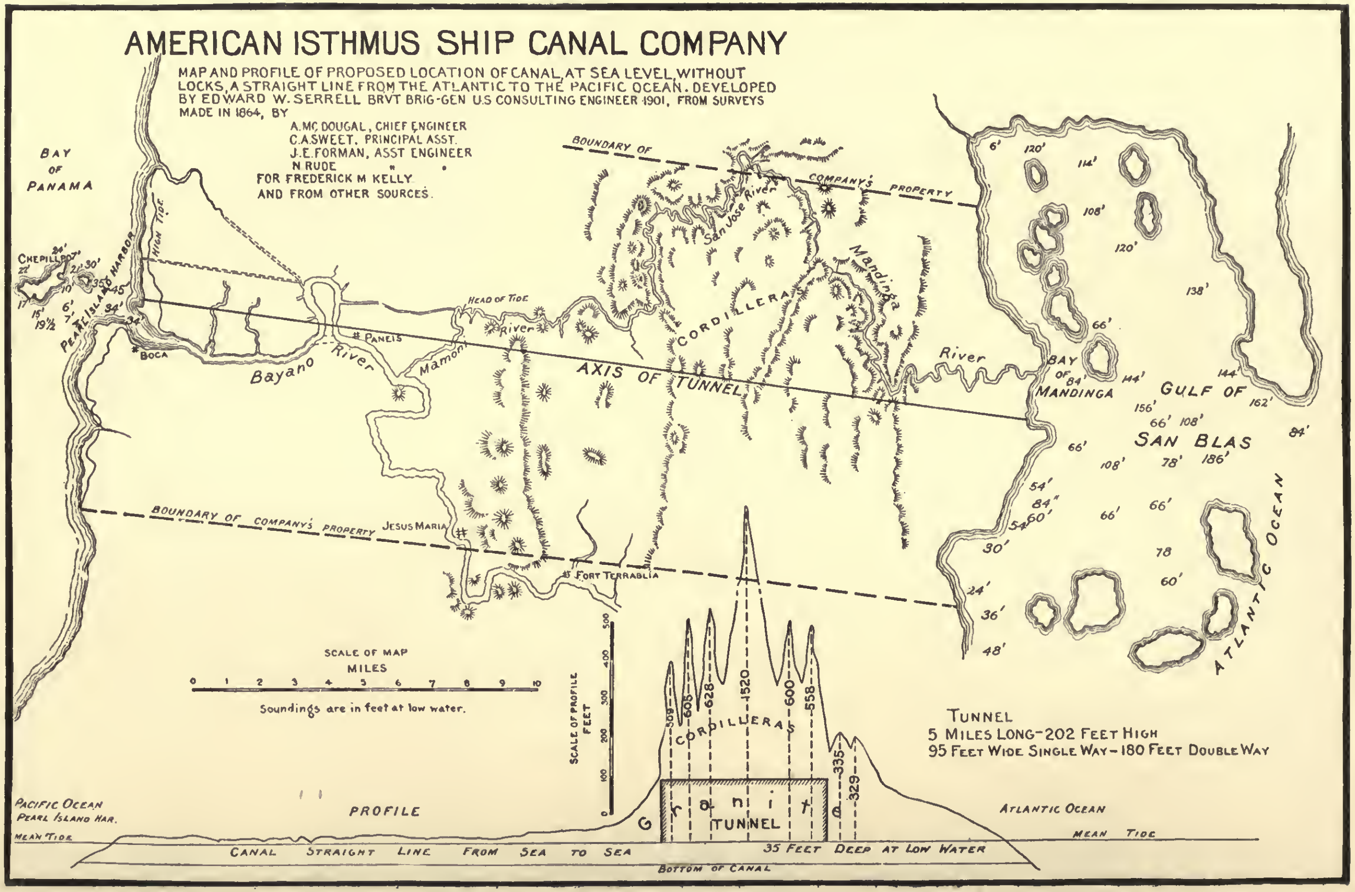
"By examining the following tabular statement the points of difference between the Mandingo and the Nicaragua and the Panama lines are readily measured.

TABULAR STATEMENT PREPARED BY AMERICAN ISTHMUS SHIP CANAL COMPANY

	MANDINGO.
LENGTH OF CANALS.	29½ Miles.
CURVES AND COURSES.	The Mandingo is a perfectly straight line at the narrowest part of the Isthmus, and normal to the coast.
TERMINAL HARBORS.	Perfect natural harbors at both ends, large enough and deep enough for the greatest demands of commerce.
LOCKS AND GATES AND DAMS.	A sea-level canal without locks or tide-gates, essentially a portion of the ocean, where shipping can pass without hindrance or delay.
WATER SUPPLY.	The united waters of the Atlantic and Pacific Oceans.
TIME OF CONSTRUCTION.	Can be done in three years.
CAPACITY OF CANALS.	Under all conditions of tide and weather, 288 ships per day with a headway of one mile.
METHOD OF TRANSIT.	Electric trolley, controlling absolutely the movement of ships.
TIME OF TRANSIT.	Five hours for sailing ships and others by trolley towage; exceptionally, steamers by their own power might go through in 3 hours.
DISTANCE FROM PORTS IN THE UNITED STATES.	From all Atlantic and Gulf ports to all South Pacific ports, a considerable gain, both as to distance and time. To all North Pacific and insular ports, a valuable gain in time.
INCIDENTS OF TRAFFIC AND MAINTENANCE.	Transit presents no dangers of collision, on account of trolley control; has little machinery to be deranged, and no delays from curvature or locks; therefore transit can be counted upon absolutely at any time.
PERMANENCE OF WATERWAY.	Constructed practically through primitive rock, banks will not wash and there can be no silting. Destructive earthquakes are unknown.
FINANCIAL.	The American Isthmus Ship Canal Company asks no money from the United States Treasury. It proposes to build the canal itself, asking the United States Government to guarantee its bonds in exchange for free transit for 100 years for the national ships.

SHOWING DIFFERENCE BETWEEN NICARAGUA, PANAMA, AND MANDINGO ROUTES

<table>
<tr><th>PANAMA.</th><th>NICARAGUA.</th></tr>
<tr><td>49.09 Miles.</td><td>183.66 Miles.</td></tr>
<tr><td>771° 39′ of curvature, 29 curves, in all 22.85 miles of curves. This curvature equals 46.54 per cent of the entire length of route. The line crosses the Chagres River 28 times.</td><td>2339° 50′ of curvature, 56 curves, in all 49.29 miles of curves. This curvature equals 26.83 per cent of the entire length of route.</td></tr>
<tr><td>Good harbor at Panama, but not so good at Colon, while at the latter place sailing vessels are often embarrassed by northers and at Panama by calms.</td><td>No harbor at all at either end. It would be necessary to make artificial harbors at an enormous expense, which, when made, would be costly and difficult to maintain.</td></tr>
<tr><td>A complicated system of locks, with a total lift of 92 feet. Many dams of large extent and doubtful maintenance: Normal lift, 85 feet; maximum lift, 92 feet.</td><td>A complicated system of locks and tide-gates, with a maximum lift of 112 feet. Many dams of large extent and doubtful maintenance.</td></tr>
<tr><td>Rain water impounded by dams in lakes, with all the contingencies of deficient rainfall or excessive rainfall. The rains are so sudden and violent that the construction of permanent and satisfactory basins must be a feat of the utmost doubt and difficulty.</td><td>The same difficulties exist at Nicaragua as at Panama, increased, however, by the greater length of the waterway, demanding a greater supply of impounded water.</td></tr>
<tr><td>Eight or ten years.</td><td>As estimated by the Canal Commission, 8 years; by others, 15 to 20 years.</td></tr>
<tr><td colspan="2">In both the Panama and Nicaragua Canals, transit of any ships at all depends upon rainfall and success in saving it. If water be plenty and locks work perfectly, 24 to 26 ships per day might go through.</td></tr>
<tr><td colspan="2">No method of propulsion being proposed for either of these canals, an expensive system of tugboats would seem to be required, or steamships by their own power.</td></tr>
<tr><td>Uncertain. If there be enough water, and locks and machinery act properly, it is possible that the time named by the Commission, 11½ hours, may be realized, but for delay where towing is needed and for difficulty with locks, a liberal allowance should be made. M. Choron, chief engineer of the New Panama Canal Company, estimates 15 hours as a minimum.</td><td>Most favorable conditions as to water supply and machinery might realize the estimate of 33 hours, but allowances must be made for detention at curves and for delay caused by imperfect action of locks.</td></tr>
<tr><td>Suffers but slightly in comparison with Mandingo if delay from water supply and uncertainty of locks be eliminated.</td><td>To South Pacific ports far behind both the others as to both time and distance. To North Pacific ports an advantage in distance which is more than balanced by the difference in time of transit.</td></tr>
<tr><td>No certainty of transit can be depended upon as to fact or time, since all machinery is liable to become deranged, and it is not improbable that the line will be impassable from this reason for greater or less periods. The expense of maintenance of machinery must be very great.</td><td>The same must be said of Nicaragua as of Panama, and to this must be added the expense and difficulty of maintaining the artificial harbors. Storms upon Lake Nicaragua are frequent.</td></tr>
<tr><td>Very much of the line must be dug through mud and sand, which will have to be kept dredged at a continual expense, interfering with mercantile traffic and increasing cost of maintenance, while the danger of a broken dam, with all its fearful consequences, can never be absent.</td><td>The Preliminary Report of the Isthmian Canal Commission shows some of the dangers to the permanence of this waterway, where "the canal line passes over swampy sections." Again, we have the fearful risk of dams, and finally the Nicaragua location experiences frequent and severe seismic disturbances.</td></tr>
<tr><td>If this line is adopted the rights of the several French corporations, together with their concessionary complications in Colombia, must be determined accurately (a work of no little time and difficulty), and such rights and concessions paid for, at a cost of $40,000,000, as estimated by the Commission, and $144,000,000 more of public money spent to finish the canal, which estimate is considered by many authorities much too low.</td><td>Here the government must expend, according to the estimate of the Commission, upwards of $189,000,000, raised by taxation, while other authorities maintain that the ultimate expense will be much greater.</td></tr>
</table>



AMERICAN ISTHMUS SHIP CANAL COMPANY

MAP AND PROFILE OF PROPOSED LOCATION OF CANAL AT SEA LEVEL WITHOUT LOCKS, A STRAIGHT LINE FROM THE ATLANTIC TO THE PACIFIC OCEAN. DEVELOPED BY EDWARD W. SERRELL BRVT BRIG-GEN U.S CONSULTING ENGINEER 1901, FROM SURVEYS MADE IN 1864, BY
A. MC DOUGAL, CHIEF ENGINEER
C.A. SWEET, PRINCIPAL ASST.
J.E. FORMAN, ASST ENGINEER
N RUDE " "
FOR FREDERICK M KELLY
AND FROM OTHER SOURCES.

TUNNEL
5 MILES LONG – 202 FEET HIGH
95 FEET WIDE SINGLE WAY – 180 FEET DOUBLE WAY

GEOGRAPHIC NOTES

INTERSTATE MIGRATION

At least one person in every five native-born Americans is living in a state other than that in which he was born—a striking instance of the mobility of the people of the United States. The native population of the United States, according to the last census, was 65,843,302, of whom more than one-fifth, or 21.3 per cent, were living in adopted states.

It is interesting to note the number of sons and daughters which the different states have sent out. New York has sent out more than 1,300,000, Pennsylvania nearly 1,000,000, Ohio more than 1,100,000, Illinois over 1,000,000, and Indiana, Iowa, Kentucky, Missouri, Tennessee, and Virginia, over half a million each. Proportionally to her population, Vermont has given to her sister states more than any other member of the Union. Vermonters equaling in numbers nearly one-half of the present native population of the state are now living in other states. Virginia, Vermont, New Hampshire, Nevada, Maine, and Delaware have each sent out numbers equaling about one-third their present native population.

Numerically Illinois has received more citizens from other states than any other member of the Union—nearly a million; 855,000 have entered Missouri, 838,000 Texas, and over half a million New York and Ohio. The states that show a net gain from this intermigration are Massachusetts, Rhode Island, and Connecticut of the New England States, New Jersey, West Virginia, and Florida of the Atlantic Coast States. The other New England States and New York, Pennsylvania, and all the Southern States as far as Mississippi have suffered net losses. For instance, New York has had a net loss of 666,000, Ohio 612,000, and Virginia 455,422. Indiana, Illinois, Wisconsin, and Missouri, the great states of the middle West, have each experienced considerable net losses, while Michigan, Minnesota, Iowa, Arkansas, Louisiana, and all the states west of the Pacific coast have made gains. Texas has gained the most of all—629,000. Kansas comes next, with a gain of 422,000, and California third, with 364,000.

U. S. WEATHER BUREAU

The United States Government spends annually somewhat over one million dollars on its weather service. In return it is estimated by conservative financial interests at least twenty million dollars are saved annually to the people of the country by the advance storm warnings to shipping along the Atlantic and Pacific coasts and by flood warnings to the people living on the banks of our great rivers. Such an investment, annually yielding an income twenty times the principal, or, in other words, which pays yearly dividends of 2,000 per cent, is somewhat rare.

The last annual report of the Chief of the Weather Bureau, Prof. Willis L. Moore, describes the work of the Bureau during 1900–1901. In addition to the weather forecasts, the Bureau is carrying on extensive work in many other lines. Snow bulletins, issued in the Rocky Mountain region, give complete information as to the depth and character of the snowfall in the mountains—information that bears on the probable water supply for irrigation during the summer. Experiments are being made in wireless telegraphy ; the revision of the barometric system for the United States, Canada, and West Indies has been practically completed under the direction of Prof. F. H. Bigelow ; the climate and crop service has been extended; 60 new storm-warning towers have been erected along the Atlantic coast. The professors and officers of the Weather Service are also doing important work in promoting interest in the study of meteorology by giving lectures before the schools and universities of the country.

TWO FAMOUS MAPS OF AMERICA

THE oldest map on which the name America appears, and the first large map to show the Columbian discoveries, has recently been found in Germany. The map was made in the first years of the 16th century, by the famous German cartographer, Martin Waldseemüller, and given to the world in 1507. To accompany the map, Waldseemüller published at the same time a brief treatise in Latin, entitled "Cosmographiæ Introductio," accompanied by an appendix containing translations of the letters of Amerigo Vespucci. It was in this work that Waldseemüller proposed to call the new world after Amerigo, evidently believing that Amerigo was its discoverer. The suggestion was adopted, and first the southern continent and later the entire western hemisphere was called after him. A few copies of the treatise are still extant, several being in American libraries, but the map, though fully 1,000 copies were printed, soon disappeared, and one copy has only just now been accidentally discovered in the library of Prince Waldbourg, at Wolfgegg Castle in Würtemburg.

Several years after the publication of this map Waldseemüller learned of his error in crowning Amerigo Vespucci as the discoverer of America and on his later maps omitted the name "America." But the thousand copies of his first great map had been scattered throughout Europe, so that the name had become too firmly rooted to be displaced. A copy of one of these later maps, printed in 1516, on which the name America does not appear, and which had likewise utterly disappeared, was found in Prince Waldbourg's library at the same time. On this map, for the name "America" is substituted the name "Brazilia sive Terra Papagalli" (the land of parrots).

The maps are wood-cut engravings. Each is made of twelve sheets, to be pasted in three rows, four sheets in each row. Waldseemüller probably intended them for wall maps, which helped moisture and time to make away with the copies. The sheets of the maps found in Prince Waldbourg's library had been bound in a large folio volume, which protected them from the ravages of dust and decay.

It will not be long before Americans will see a facsimile reproduction of the maps. The fortunate finder, Prof. P. J. Fischer, and Dr. Von Wieser, a distinguished German geographer, who had for years been hunting unsuccessfully for the maps, are hastening to reproduce them in facsimile.

THE DANISH WEST INDIES

THE three islands of the Danish West Indies combined are about twice the size of the District of Columbia. Thirty-five years ago Denmark offered to sell them for $15,000,000, but finally accepted Secretary Seward's offer of one-half that sum. Secretary Seward, however, did not have his way with the United States Senate, and the islands remained in Denmark's possession. Now Denmark is willing to sell them for $4,500,000. The story of these figures tells not only the value of the islands to Denmark, but also is an index of their present condition.

St. Thomas, the smallest and most populous of the three, has the best harbor, Charlotte Amalie, and is the most important. It is 30 miles east of Porto

Rico. Less than one-tenth of the people living on the islands are white. No color line is drawn, and whites and blacks enjoy the same privileges in the churches, schools, and in business. Intermarriage is quite common. Everybody speaks English, and while the official language is Danish, English is used in the schools and courts. Nearly everything that is used for the table—flour, fruits, vegetables, salt canned meats—is imported for the most part from the United States.

On the island of St. Croix there are a number of fine sugar estates, the product of which all goes to New York. The islands, however, are not cultivated to their former extent, and are now almost bare and covered only by a scrubby vegetation, from amidst which the ruins of plantations can here and there be discerned. The climate of the islands is quite healthy, contagious diseases but rarely troubling them.

The old-time prosperity arose from the fact that while the other nations owning possessions in the West Indies were fighting, Denmark remained strictly neutral. In the large land-locked harbor of St. Thomas, a free port, privateers, men-of-war, and merchant vessels could meet in safety and obtain supplies. Its importance as a distributing point has since been gradually declining, and the general depression affecting nearly all the West Indies has been sharply felt.

The possession of St. Thomas by the United States will give this country a more strategic position in the West Indies. The harbor is more accessible and more easily defended than the San Juan harbor of Porto Rico.

THE COUNTRY OF ABYSSINIA

IN November, 1900, Emperor Menelik invited Hugues Le Roux, the distinguished Frenchman, to visit his country. The Emperor desired Abyssinia to be visited by a European of distinction and experience, who should be able to judge with impartiality the degree of culture of his people, the wisdom of his laws, and the nature of the agricultural, commercial, and other resources of the kingdom. Entering Abyssinia under such circumstances, M. Le Roux naturally received every opportunity and assistance. He spent the earlier months of 1901 visiting the Emperor at his capital and later in performing some very important explorations in southern Abyssinia, supplementing the work south of the Blue Nile which Mr. Oscar T. Crosby, of the National Geographic Society, had done north of the same river. M. Le Roux has written the expected volume, describing what he saw and learned. The volume, handsomely illustrated, is to be published by Librairie Nilsson (Paris) and is one of the most interesting on the king, people, and country of Abyssinia that has yet been published. A map giving his explorations in detail was published in *La Géographie* for October 15, 1901.

MINERAL PRODUCTS OF THE UNITED STATES IN 1901

IF all the petroleum produced last year in the United States was put in standard barrels and the barrels placed in a row touching each other, the line would completely belt the earth. Enough coal was produced to give three and one-half tons to every one of the 76,000,000 persons in the United States, and enough gold to give every American one gold dollar. In coal, in iron, in steel, in gold, in silver, in every mineral product except copper, the products of the United States last year reached the highest record in the history of the country.

The silver production of 1901 reached 59,653,788 ounces, against 57,647,000 ounces in 1900. The pig-iron production is estimated at 15,800,000 long tons, against 13,789,242 long tons in 1900, when the figures exceeded those of any preceding year. The output of coal is estimated at 267,850,000 long tons, against 240,965,917 long tons in 1900, the year of highest production heretofore. Of petroleum, the production is estimated at 2,772,000,000 gallons, against 2,661,233,568 gallons in 1900, the highest previous record. Of copper, the only item in the entire list which shows for 1901 a smaller figure of production than that of 1900, the production is estimated at 265,625 long tons, or about 5,000 tons below the figures of 1900.

Those who wish to study this unequaled record in our mining and metallurgical industries will find in the *Engineering and Mining Journal* for January 4, 1902, a comprehensive review of the year's progress in each mineral product. The *Journal* has recently been greatly enhanced in value and scope through the able leadership of the new editor-in-chief, Dr. David T. Day, Chief of the Division of Mines and Mining of the U. S. Geological Survey, and of the new managing editor, Mr. Edward W. Parker, also of the Geological Survey.

BOLIVIA

SOME years ago the Bolivian Government made an attempt to establish a water route to the Atlantic by sending its commerce down the river Madeira, and thence by the Amazon, more than one thousand miles to the ocean. Though they had ample funds to make the improvements in the water route that were necessary for shipping, the enterprise was finally abandoned. Recently another attempt has been made to discover a water route eastward, but this time by means of the Paraguay, which would carry her commerce to Buenos Aires, also a trip of 1,000 miles to the sea. In the *Geographical Journal* for January, Col. George Earl Church describes the attempt made by Captain Bolland on behalf of the Bolivian government to find an outlet eastward. After prolonged search and exploration along the Alto Paraguay, Captain Bolland reported that the only point where a port could be established on this river without great expense was at Lake Gaiba. This point is about 1,000 miles up the Paraguay from Buenos Aires, and can be reached by river steamers without further dredging of the river; but as Lake Gaiba is nearly 400 miles west of the present productive region of Bolivia, her products would have to be carted this distance to reach the steamers. Long and tedious these river routes would be; but they would save Bolivian merchants from the expense of hauling their products up the eastern side of the Andes, only to be carted down the western slope to the Pacific. On the Pacific coast they would also be thousands of miles farther away from their market. The Bolivian Government hopes to be able to develop further the Paraguay route.

COAL AND IRON IN MEXICO

THE enormous coal and mineral resources of Mexico are daily becoming more prominent, and are destined to bring the country more wealth than all her gold and silver mines. A recent number of *Engineering* contains a symposium of the diverse mineral resources of the Mexican Republic and of what is being done to develop them. In the state of Coahuila it is estimated there is a carboniferous region of nearly 5,000 square miles; in Sonora of 7,000 square miles; in another state a seam 6 feet thick was found at a depth of only 17 feet and followed for a distance of 10 miles, and elsewhere was found a vein 23 feet thick of coal equal to the best Lehigh Valley coal. Many similar instances of the richness of the coal beds are cited. Very rich iron deposits are also found near the coal region. In Durango is a hill of iron a solid mass of ore 640 feet high, averaging 70 per cent of metal and capable of yielding over three hundred million tons of solid iron. Nearly all her mountains are of metalliferous character. Those that appear richest in mining deposits are on the western chain, extending from the state of Oaxaca to the state of Sonora, a distance of 1,600 miles from northwest to northeast.

The statement of Humboldt some hundred years ago, that probably "Mexico would be the treasure-house of the world," may perhaps be realized.

EDWARD JOHN EYRE

An Australian explorer of sixty years ago, Edward John Eyre, died in England November 30, 1901. In 1832, then seventeen years of age, Eyre went to Australia to seek his fortune in sheep farming. From New South Wales he wandered to South Australia, which was then separated from West Australia by one thousand miles of unpenetrated desert and wilderness. Eyre thought that a route to the rich pasturable districts in the west of the continent might be found along the shores of the Great Australian Bight south of the desert. After several fruitless attempts, he set out, in the fall of 1840, accompanied only by one white and three native boys, for a journey of nearly 1,200 miles, not one mile of which had ever been seen by a white man. They had advanced half the distance when two of his native companions rebelled, killed his only white companion, and fled. He was left with one native boy to push on. After untold hardships, he reached King Georges Sound in the spring of 1841, where he was picked up by a French whaler that happened to be cruising along the coast.

An account of this expedition is given in the thirteenth volume of the *Journal* of the Royal Geographic Society. This work ended his geographical labors. In 1845 he returned to England, received various colonial appointments, ending with that of Governor of Jamaica in 1864, and at the end of that year retired to private life.

The Report of the Superintendent of the Coast and Geodetic Survey, Mr. O. H. Tittmann, for the last fiscal year describes some of the important work upon which the Survey is engaged. During the year the survey of the coast of the Philippine Islands was commenced, and charts of harbors at all important points were made. The Survey adopted a standard datum, to be known as the "United States standard datum," to which all geographic positions throughout the United States will be reduced whenever possible. An important contribution to the subject of geodesy was completed, "the eastern oblique arc of the United States." In addition to extensive work in progress in nearly every state of the Union, surveys are being made on the coasts of Alaska, Hawaii, Porto Rico, and the Philippine Islands. A survey to determine the magnetic elements is in progress at several hundred stations distributed over many states and territories, in all the island possessions, and in Alaska, and British Columbia.

The Work the U. S. Fish Commission is doing throughout the country is described in the report for 1901 of the director of the Commission, Hon. George M. Bowers. During the last fiscal year 1,173,833,400 fish and eggs were distributed. Most of these were shad, salmon, lake trout, whitefish, pike, perch, lake herring, cod, flatfish, and lobsters. In Lakes Superior and Michigan, 224,000,000 lake trout eggs were collected, from which 19,000,000 fry were hatched. Many lakes and rivers were stocked during the year; as many as 160,000,000 eggs were placed in the Missisquoi River, in Vermont, while 42,000,000 eggs were taken from Lake Erie to Michigan. The report comments on the increasing scarcity of lobster eggs along the coast of New England, especially south of Cape Cod. The Commission planted in New England waters during the year 202,870,000 cod, 44,000,000 flatfish, and 60,000,000 lobsters.

The Russian Expedition, under Lieutenant Kozloff, to explore the sources of the Yellow and Yangtze Rivers, has returned to Irkutsk in safety, after having made very important surveys in Western China.

A Map of the Bisayan Group of the Philippine archipelago has just been published by the Military Information Division of the War Department. It is on the scale of eight miles to an inch and shows with much detail the geographic features of Panay, Negros, and the other islands of the Bisayan group.

Clarence King, geologist and geographer, died at Phœnix, Arizona, December 26, 1901. In 1863 he crossed the American continent on horseback and joined the California Geological Survey, later discovering and naming mounts Whitney and Tyndall. From 1867 to 1872 he commanded the expedition for the geological survey of the 40th parallel; and organized and was the first director of United States Geological Survey, 1878–'81. To his palæontological discoveries are largely due the evidence which has determined the generally accepted age of gold-bearing rocks.

American Progress in Cuba.—Major W. C. Gorgas, chief sanitary officer of Havana, in his last report presents striking evidence of American progress in that city. During the month of September 16,121 houses were inspected and oiled by the mosquito brigade, but only 1.5 per cent were found to have mosquito larvæ on the premises. When the first inspection was made last March every house had deposits of larvæ. For three months in succession there has not been a single case of yellow fever in the city for the first time in its history. The death rate in the city is now 20.47 per thousand, whereas the minimum death rate during the last nine years of Spanish rule was 28.32 and the maximum 100.08 per thousand in 1897.

The American Museum of Natural History has received preliminary information as to the results of the Jesup North Pacific expedition sent to northeastern Siberia in the summer of 1900. The object of the expedition was to study the points of similarity between the people of northeastern Siberia and the natives of Alaska and British Columbia. The museum announces that definite proof has been obtained that the tribes of northeastern Siberia and northwestern America in early times had more or less intimate connections, partly inferred from the great similarity in their customs and myths.

The Interstate Commerce Commission has in preparation a "Ten-year Book on Railways in the United States." The volume contains tables showing the mileage, equipment, earnings, capital, accidents, etc., of the different railroads, and a summary of the statutory provisions of the states and of the federal government pertaining to the taxation of railway property, the administration of railway commissions, etc., and of the laws that limit, direct, and control the business of transportation by rail.

The Cape to Cairo Telegraph now stretches from Capetown 2,500 miles north, or a few hundred miles less than from New York to San Francisco. The latest station put up is at Ujiji, on the eastern shore of Lake Tanganyika. It is a question now of only a few months before the wire will be strung as far as Fashoda and the circuit between Egypt and South Africa be complete.

A Gazetteer of the Philippine Islands has been compiled by the Insular Division of the War Department. It contains much information about the civil and military governments, the means of transportation, the cable and postal stations, and other matters of interest. The gazetteer will soon be ready for distribution.

A Map of Mount Hood and Vicinity, Oregon, has been published by the Geological Survey. It is on a scale of two miles to an inch and shows in detail the timber resources of the mountain and its neighborhood. A complete reconnaissance map of the Cascade Range in Oregon on a scale of four miles to an inch has also been prepared.

Texas Petroleum is the title of a very comprehensive bulletin published by the University of Texas Mineral Survey and prepared by W. B. Phillips, Director of the Survey. It gives a historical sketch of the discovery of oil in Texas, describes the nature and origin of the petroleum, of the oil and gas bearing formations, and of its use as fuel. Dr. Phillips states that the oil is being substituted for coal in some Texas establishments; locomotives are being equipped for oil, and that it is being used for laying the dust on streets, and for other equally practical purposes.

The Census Office has published in one volume all the returns relating to the population of the United States obtained by the census of 1900. A series of admirable charts, prepared by Mr. Henry Gannett, Geographer of the Census, illustrate the density and distribution of the population, the sections where the negro and the foreign elements are concentrated, and the other facts revealed by the census. These charts will later be embodied in the "Statistical Atlas," which is being prepared under Mr. Gannett's direction. The general nature of the Atlas will be similar to that for the eleventh census, but of a smaller and more convenient size.

The Progress of the United States in its material industries, a valuable monograph issued by the Treasury Bureau of Statistics, shows in striking manner the rapid development during the past century of the important factors in the present prosperity of the country. The enormous increase in products of the field, forest, mine, and manufactory, the growth in our population, wealth, and commerce, and the extension of railways and telegraphs are clearly presented in a series of clever tables.

A new edition of Stieler's Hand Atlas is being published by Justus Perthes. The atlas will contain 100 copper-plate maps, which are being issued two at a time at intervals of two or three weeks. The price of the complete work is $7.50. This is the ninth edition of this notable atlas, the first having been completed by Stieler in 1831.

The Guide to the Great Siberian Railway, published by the Ministry of Ways of Communication, St. Petersburg, contains a vast amount of geographic matter about Siberia. The volume consists of over 500 large octavo pages, is handsomely illustrated, and gives for each section of the country a bibliography of official, historical, and geographic works.

The Bureau of American Republics has published a bibliography of books, magazine articles, and maps printed during the nineteenth century relating to Brazil. The volume was prepared by P. Lee Phillips, and forms a supplement to the handbook of Brazil recently published by the bureau.

GEOGRAPHIC LITERATURE

Through the First Antarctic Night. By Frederick A. Cook, M. D. Illustrated. New York: Doubleday & McClure Co.

Dr. Cook has the unique distinction of having explored the two ends of the earth. He has worked with the Peary expeditions in the far north, and was an important member of the first party of men ever to winter within the Antarctic Circle. The volume which he has recently published, giving the results of the two years' work of the party on the *Belgica*, forms a notable work. As the surgeon and anthropologist of the expedition, Dr. Cook was naturally most interested in the problems of animal life. There is an interesting chapter on the Fuegian "giants," who average at least six feet in stature; on the great sheep farms of southern Patagonia, where the climate is so mild and pasturage so easy that one shepherd can guard 2,000 sheep; on the geographical discoveries by the expedition, including Belgica Strait and the tracing of a considerable coastline, and on the long South Polar night. The effects of the winter darkness, Dr. Cook believes, are much more severe in the south than at the opposite end of the world. The unceasing storms are harsher and more depressing. Dr. Cook tried the experiment of making his men stand daily for an hour half naked before the fire, and found that the stimulating effect of the sun was thus partly obtained. In an appendix to the volume are included the scientific results obtained by the various members of the expedition. Dr. Cook has given the public an interesting and instructive volume, handsomely illustrated by photographs taken by himself. To gain an idea of what the three expeditions sent out by England, Germany, and Sweden, and now in the far south, are experiencing and aiming for, one could not do better than read "Through the First Antarctic Night."

Dr. Frederick A. Cook

Descriptive Geography from Original Sources. North America. Illustrated. Edited by F. D. and A. J. Herbertson. London: A. & C. Black. 1901. $0.75.

The selections in this volume have been made with much care and wisdom and the editors are to be congratulated on their success in giving interesting and accurate original descriptions of many geographic features. A work of this nature, however, being a compilation of extracts from many authors, necessarily lacks unity and symmetry. Each description appears more or less independent of the others. American exploration of Alaska has been so rapid in recent years that it is perhaps not surprising that this work is several years behind in its information regarding the great territory. There is also no reference in the volume to the wheat and corn areas of the United States, though the "Bad Lands" are described.

Dutch Life in Town and Country. By T. M. Hough. With illustrations. New York: G. P. Putnam's Sons. 1901. $1.50.

Mr. Hough presents an interesting picture of Dutch life, more particularly in his chapters on "Court and Society," "The Professional Classes," "The Peasant at Home," "The Administration of Justice," and "The Canals and Their Population." About 50,000 persons live on barges all the year round and form a "canal population." For generations they have been left to themselves, a class apart, and have given color and picturesqueness to the inland waters of Holland; but the spirit of reform is in the air—the government is beginning to interfere, to insist on the education of the barge children, so that in a few years this unique population will disappear. The volume is one in the notable series on "Our European Neighbors," which the Putnams are publishing.

The Bolivian Andes, a record of climbing and exploration in the Cordillera Real in the years 1898 and 1900. By Sir Martin Conway, with illustrations. New York: Harper & Bros.

This book is a narrative of one successful ascent, that of Illimani (21,192 feet), and of two failures, on Sorata and Ancohuma. Were this merely a narrative of these climbs, the book would be dreary reading, but fortunately it contains much more. The author introduces his readers to the central and one of the highest parts of the Andes, to the great desert plain, the Puna, the summit of the Andean plateau, which forms the base of the great peaks, and to the human life of this scarcely known region, in a most charming and interesting manner. The rubber industry and the gold and tin mines of the region visited are treated also with fulness. A map would have added greatly to the value and interest of the book.

South Africa a Century Ago (1797–1801). By Lady Anne Barnard. New York: Dodd, Mead & Co.

Lady Anne Barnard was the wife of the first secretary of Cape Colony. She was a clever, observing woman, in the habit of writing to her friend, the Secretary of State at home, her manner of life in South Africa. Her letters are published in this volume, but are rather disappointing, as they have more to say about the garrison life of her set than of the people of the Cape.

History of Geology and Palaeontology. By Karl Alfred Von Zittel, translated by M. M. Ogilvie Gordon. Illustrated. London: Walter Scott. 1901. $1.50.

A scholarly work, designed for the specialist and of doubtful interest to any one else.

Macmillan's Guides, 1901.—*Italy.* With 51 maps and plans $2.50.

The Eastern Mediterranean. With 27 maps and plans. $2.25.

The Western Mediterranean. With 21 maps and plans. $2.25.

Palestine and Egypt. With 48 maps and plans. $2.50.

These excellent guide books are specially noteworthy for their many beautifully engraved maps and for their convenient size. The editors have given particular attention to the historical, archæological, and artistic features of the countries, and have also included at the end a list of standard books about each country.

Isthmian Canal Routes.—In view of the prominence of the Isthmian Canal problem, it may not be inappropriate to direct attention to the following articles on this subject that have appeared in the NATIONAL GEOGRAPHIC MAGAZINE during the last several years:

"The Nicaragua Canal," abstract of the preliminary report of the Isthmian Canal Commission, January, 1901.

"The Level of Lake Nicaragua: A Question of Permanency of the Nicaragua Canal," C. Willard Hayes, April, 1900.

"The Water Supply for the Nicaragua Canal," Arthur P. Davis, September, 1900.

"The Isthmian Routes," Arthur P. Davis, July, 1899.

"Physiography of the Nicaragua Canal Route," C. Willard Hayes, July, 1899.

"The Proposed American Interoceanic Canal in its Commercial Aspects," Joseph Nimmo, August, 1899.

"The Interoceanic Canal," Emory R. Johnson, August, 1899.

"The Panama Canal Route," Robert T. Hill, February, 1896.

"The Tehuantepec Ship Railway," E. L. Corthell, February, 1896.

"The Nicaragua Canal," A. W. Greely, February, 1896.

NATIONAL GEOGRAPHIC SOCIETY

PROCEEDINGS

MEETINGS OF THE SOCIETY:

January 10, 1902, Annual Meeting.—President Graham Bell in the chair.

The President gave an address on the "Growth and Prospects of the National Geographic Society," which will be published later in this Magazine.

The report, 1901, of the Secretary, Prof. A. J. Henry, was submitted, showing the membership of the Society, December 31, 1901, as 2,661. Of this number 1,592 members are resident outside of Washington, and represent every state and territory of the Union and nearly every nation of the world; 1,025 are resident in Washington, 32 are life members, and 12 honorary members.

The report of the Treasurer, Mr. John Joy Edson, was submitted, showing that on December 31, 1901, the treasury of the Society had a balance of $2,257.

January 24.—President Graham Bell in the chair.

Dr. L. A. Bauer, of the U. S. Coast and Geodetic Survey, read a paper on "The Magnetic Survey of the United States," and Mr. James Page, of the U. S. Hydrographic Office, a paper on "Ocean Currents." Both papers will be published later in this Magazine.

LECTURES:

January 3, 1902.—President Graham Bell in the chair.

Hon. John W. Foster, ex-Secretary of State, gave an illustrated address on "The New Mexico." The paper was published in the January number of this magazine.

January 17.—President Graham Bell in the chair.

Gen. A. W. Greely, Chief Signal Officer of the U. S. Army, gave an illustrated address on "American Progress and Prospects in the Philippines." Further notice of this address will appear later.

January 31.—Vice-President McGee in the chair.

Capt. James F. T. Archibald, tha war correspondent, gave an illustrated address on "Present Conditions in South Africa," which will be published later.

ANNOUNCEMENTS.

LECTURES:

February 14.—"The Proposed Appalachian Forest Reserve," Hon. James Wilson, Secretary of Agriculture, and Prof. Joseph A. Holmes, State Geologist of North Carolina.

February 28.—"Fifty Years of Immigration," Hon. E. F. McSweeney, Assistant Commissioner of Immigration.

MEETINGS OF THE SOCIETY:

February 7, 1902.—"Some American Work in Cuba," Major W. M. Black, Corps of Engineers, U. S. Army.

February 21.—"Notes on the Geography of Alaska," Alfred H. Brooks, U. S. Geological Survey.

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THE
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GEOGRAPHIC
MAGAZINE

THE POSSIBILITIES OF ALASKA

BY C. C. GEORGESON, OF SITKA, ALASKA

SPECIAL AGENT OF U. S. DEPARTMENT OF AGRICULTURE IN CHARGE OF ALASKA INVESTIGATIONS

HE would have been considered a rash prophet who five years ago had the temerity to predict that Alaska would one day become a great and powerful state.

Yet, today, such a prediction would not be ascribed to prophetic sight, but simply a common-sense view, a foregone conclusion, based on the resources and possibilities inherent in the territory. The change of opinion is due to the fact that it has been demonstrated that Alaska has agricultural possibilities of a high order. The development of agriculture will enhance the value of the other vast and varied resources of the territory a thousand fold. It will make it possible to work the extensive placer mines not rich enough in gold to pay at the present prices for foodstuffs, as well as the enormous deposits of low-grade quartz ores found nearly everywhere in the mountains.

Alaska has been maligned, abused, and totally misunderstood. It has been regarded as a frozen, worthless waste, whose only value consisted in its seal fisheries, and totally incapable of furnishing homes for a civilized people. These ideas are still current even in quarters where one would naturally expect to find a knowledge of the facts. Through the instrumentality of Secretary Seward, Alaska was purchased from Russia in 1867, for the sum of $7,200,000. It has already paid for itself many times over, and still we have scarcely begun to realize how enormous the resources are. What the profits to the lessees of the sealing privilege have been will probably never be made known, but it is interesting to note that the rentals received or due the government for the lease of this privilege from 1870 to 1895 amounted to almost the original cost of the territory, namely, $7,192,540.41 (Senate Document No. 81, 54th Congress, 2d session); and as to the income from mines, it is commonly reported that more than an equal sum has been taken from a single mine near Juneau, to say nothing of the millions taken out in other places.

Alaska has an area of 591,000 square miles, in round numbers; that is to say, it is as large as all of the United States east of the Mississippi River, exclusive of the four states of Florida, Georgia, Alabama, and Mississippi. It requires an effort of the mind to grasp the significance of such an expanse of territory. There never could be a greater misconception in regard to a geographical fact than the popular idea that it is a snow-covered, inhospitable waste, and it is strange that this idea should be so persistently propagated and disseminated among the people. As a matter of fact, you can travel from one end of the Yukon to the other in summer time and never see snow. You see, on the contrary, a tangle of luxuriant vegetation, large forests, and such delicacies as wild raspberries, red currants, huckleberries, and cranberries in profusion. In places the grass grows as high as a man's shoulder. At Holy Cross Mission I desired to photograph some cattle, native born, reared by the fathers, and for that purpose asked that they be turned into a meadow reserved for hay. To my astonishment I found that the cattle were totally out of sight when they got into the grass, which reached above their backs.

Alaskan tourists are largely responsible for the false conception which is abroad in regard to the agricultural possibilities of the country. The high mountain range which skirts the sea coast is covered with snow and glaciers. It has a rugged, forbidding aspect. People who go as far north as Skagway and back again to Seattle in a two weeks' trip fondly imagine that they are studying Alaska, and that they are quite prepared to pass judgment on the whole territory, when, as a matter of fact, they have not been within 200 miles of the 141st meridian, where Alaska proper begins. To get anything like a correct idea of Alaska, one must go inside.

WHAT EXPERIMENT HAS PROVED

Facts ought to carry greater weight than theories founded on misconception. Now the facts are that all the hardy vegetables are grown with marked success all over Alaska south of the Arctic Circle, except on the coast of Bering Sea. I have never seen finer potatoes, cauliflower, cabbage, kale, peas, lettuce, and radishes than have been grown at the experiment stations at Sitka and Kenai. At Dawson I have seen a magnificent display of native-grown vegetables comprising all the hardy kinds; and at the Chamber of Commerce rooms of that town are displayed fine samples of barley, oats, and wheat in many varieties, perfectly normal in all particulars, and grown there by a local experimenter. At Eagle I have seen all the foregoing crops, and in addition a luxuriant growth of sweet peas, poppies, mignonette, and a host of other flowers in full bloom. At Holy Cross Mission I ate new potatoes, cauliflower, cabbage, carrots, beets, lettuce, and radishes in the beginning of August, all produced in the Mission gardens. At Rampart, in latitude 65, a station was established by the Department of Agriculture in the summer of 1900. Winter rye, seeded there in August of that year, lived through the winter perfectly under a good covering of snow. Although the temperature fell to 70° below zero, it came out in the spring in perfect condition, and matured grain by the first of August, 1901. Barley seeded in May of the latter year was ripe by the middle of August. At the headquarters station at Sitka I have for three years past grown as fine spring wheat as one would wish to see (samples of it may be seen at the Department of Agriculture), and barley and oats have been grown there successfully for four years. These grains have likewise been grown successfully at the experiment station at Kenai, on the Kenai Peninsula. This station is situated in a region where there are thousands of square miles of land available for farming and grazing. Captain W. R. Abercrombie, who constructed the trans-Alaskan military road, at my request seeded the past summer small quantities of wheat, barley, and oats at Copper Center, in the Copper River Valley, and he writes me that they all matured. Ripe oats were seen last September by Mr. Isaac Jones, an employee of the Department of Agriculture, on a tributary to the Forty-mile, in about latitude 64. Two Wisconsin men, Messrs. H. C. Nicolai and D. H. Clark, started to farm at Skagway two years ago. In September of last year I saw considerable fields of oats, potatoes, and cabbage grown by them. On Admiralty Island, near Killisnoo, a man named Thomas Baker has been growing vegetables and grains for years with noted success. Small patches of grain have been matured at Kadiak, at Afognak, at the Moravian Mission on the Kuskokwim River, and at many other places. At Fort Selkirk an American named Frank Bach, and at Dawson two brothers named Morgan, also Americans, have secured from the Canadian Government tracts of upward of a hundred acres of land each, which they are farming successfully.

STOCK-RAISING

Cattle are kept at every considerable settlement in Alaska, except perhaps at Nome. They all do well. The treeless region to the westward of Sitka is especially well suited to cattle and all kinds of live stock. The Alaska Commercial Company has kept cattle, sheep, and Angora goats at Kodiak for many years, and they required but little feed and shelter, except in an occasional storm during winter. The data on these experiments were published in the report to Congress on the Alaska Investigations for 1899. The natives at Kenai and Ninilchik, on Cook Inlet, have kept cattle for half a century or more. At the latter place they have upward of thirty head. But few breeding cattle have as yet found their way into the interior, but horses are quite numerous there. In this connection it is of interest to note that in spite of the extremely cold winters in the interior, there are many instances on record in which horses abandoned by prospectors in the fall have survived the winters and come out in the spring in fair condition. Mr. Mark E. Bray, an American miner, told me last summer that he used five mules in his mining operations on one of the tributaries of the Tanana. He abandoned them when he went out in the fall, it being too expensive to buy feed for them in Dawson, where he wintered. When he returned to the diggings the following April he found four of them alive and well; the fifth had been killed by the Indians. In the fall of 1899 Mr. Jack Dalton turned loose forty-five head of pack horses he had used in carrying provisions over the Dalton trail, and in the spring of 1900 he found forty-three of them alive and well and in fair condition.

AGRICULTURAL LANDS

There are extensive areas of grass land in many parts of the interior. Mr. Isaac Jones, already referred to, made a reconnaissance last summer between Eagle, on the Yukon, and Valdes, on Prince William Sound. The distance between these two points as the trail runs is about 435 miles. He examined some fifteen miles on either side of the trail, thus covering an area of thirty miles wide by 435 miles long. Within the boundaries of this strip he estimates that he saw two million acres of pasture and farming land. In the region occupied by the Kechumstuk Indians, north of the Tanana, and especially along the south fork of the Forty-mile, he reports that he crossed a meadow with the grass waist high for a distance of eight miles. He also learned of horses which had run at large for two years in this region. The Kechumstuk Indians have given a new name to cattle. They call them "McKinley moose," and Americans were known to them as "McKinley men." The chief of the village had secured an American flag, which he hoisted on a tall pole whenever he learned that white men were in his territory. There is some hope for the civilization of a tribe which cherishes such sentiments. Mr. Jones' description of the country is highly interesting. It forms part of my report now before Congress.

WHAT IT MEANS

The development of agriculture in Alaska means the settlement and development of the territory. It means the making of homes, a permanent population, the rapid development of the mineral resources, the creation of wealth, the building of a state. If, on the other hand, no foodstuffs can be produced in Alaska, a large population is impossible, and it could never become a state. We cannot imagine the possibility of sustaining even one hundred thousand people there if all that they required to support life must be brought from the states, a thousand miles distant, and carried hundreds of miles more from the ports of entry to the mining camps and villages in the interior. Under such conditions development of the natural resources must languish. Agriculture is the backbone of prosperity. An adequate food supply is the first essential to the growth of population, to prosperity, to greatness, and if this factor were lacking in Alaska, it would be doomed to remain a scantily populated territory. States with little or no agriculture make no growth. Look at Nevada, for instance. But it is fortunate for Alaska, and therefore for the whole country, for the growth of any section benefits the whole, that she has agricultural possibilities to an extent which will make the fullest development of her resources practicable. Alaska can furnish homesteads of 320 acres each to 200,000 families. She has abundant resources to support a population of at least three million people. Such a population would mean a volume of trade which would yield an immense and permanent income to the coast states. There are people who fear that the development of agriculture would prejudice the mining interests. Nothing could be further from the truth. On the contrary, it would be of the greatest possible help to the mining industry. It would reduce the cost of living, make labor more plentiful, and therefore cheaper, and give rise to better transportation facilities. It would then become possible to work the low-grade mines with profit, and to materially increase the profits of the good mines.

THE EXAMPLE OF FINLAND

The foregoing statements are borne out by the example of Finland. This little country lies wholly north of the 60th parallel. Alaska reaches six degrees south of this latitude. Finland is less than one-fourth the size of Alaska, and its agricultural area is less than 50,000 square miles; yet in 1898 Finland had a population of over 2,600,000 souls. Agriculture is the chief industry. Only about 300,000 people are city dwellers. They export large quantities of dairy products, live stock, flax, hemp, and considerable grain, and the population has increased some 825,000 in the last twenty-eight years, and this in spite of a very considerable emigration. The conditions in Alaska from an agricultural standpoint are more favorable than those of Finland. We have a larger agricultural area, somewhat warmer summers, and the mines will yield the best possible home market. When the fishing industry of Alaska is developed, it will engage the labors of hundreds of thousands of people, who must be fed in large measure from the farms. Alaska has a coast line of 26,000 miles, practically all of which affords splendid fishing ground. The salmon is as yet the only fish which has attracted attention. There are thousands of square miles of cod banks, the enormous halibut grounds have not been touched, and the myriad shoals of herring go by unheeded. An oil and guano factory has been established for some years at Killisnoo, a little village some distance from Sitka, in which the herring is utilized. There is room for fifty such enterprises. The guano sells readily for $30 per ton.

WHY ALASKA IS NOT SETTLED

With such facts as to resources, why is Alaska not settled? Simply because settlers cannot get title to land. There is much inquiry for land, but when the would-be settler learns the status of affairs he changes his plans. To get title, the settler must first buy soldiers' additional homestead script, which can be located on unsurveyed lands. This will cost him anywhere from $5 to $15 an acre. Then he must deposit in the surveyor general's office an amount which will cover the cost of the survey. United States deputy surveyors charge $15 to $20 a day and traveling expenses in Alaska. He must also pay for the office work, entries, etc. The result of all this is that a piece of raw land in Alaska will cost him as much as a good, improved farm in almost any state. Such conditions are prohibitive, and Alaska will not be settled as long as they prevail. Again, a homestead of eighty acres, which the law allows, is not large enough. Stock-raising must, of necessity, become a leading branch in Alaska farming, and eighty-acre stock farms will scarcely be much in demand. Three hundred and twenty acres would be more in harmony with conditions which require considerable pasture land to make farming a success. Would it not be a wise policy to make the land absolutely free to *bona fide* settlers? The great expense necessary to reach the territory with work animals, implements, and all that is required for a start, and the hardships incident to pioneer life in a rigorous climate, far from civilization, entitle the pioneer to special consideration. The development of the territory depends upon his work. He must blaze the way and bear the brunt of the battle. His courage, endurance, and self-sacrifice constitute the very foundations on which the state must be reared. The exploitation of the territory's resources by wealthy corporations will not enrich or build the state. It is the pioneer, the settler, the home-maker, who, with ax and grubbing-hoe, subdues the wilderness and forces unwilling nature to yield him a livelihood; who nurtures a family; who rears the school-house and church. It is he who is the state builder, and every practicable means employed to aid him in the onerous task will further the development of the territory.

SARICHEF'S ATLAS, 1826

BY MARCUS BAKER

IN the year 1826 the Russian Hydrographic Office, then under the direction of Vice-Admiral Gavrila Andreevich Sarichef, published a large folio atlas of northwestern America, northeastern Asia, and the waters between. This atlas comprises 33 double-page sheets, of which 26 are charts and 7 are views. It appears to be a collection of charts made during the two or three decades preceding 1826, in which year they were collected together, numbered, and issued in atlas form. The first 6 are general charts and the remaining 20 special charts of various harbors, islands, etc. Some of these are copied from Vancouver, Kotzebue, and others, and some are from original surveys by Sarichef and others. Sarichef was one of the companions of Commodore Joseph Billings, who, by command of the Russian Empress Catherine II, conducted a secret astronomical expedition in and about Bering Sea in 1785 to 1794. The earliest Russian surveys about Unalaska, after Krenitzen and Levashef, 1768–1769, were made by Sarichef in or about 1790–1791.

Some of the separate charts, afterward brought together to form this atlas, are to be found in Washington in the Coast and Geodetic Survey Office, some in the Hydrographic Office, and perhaps some in private hands. No copy of the atlas, however, so far as I am aware, exists in Washington. Indeed, the only copy of it in the United States, so far as I know, is now owned by and in the possession of Professor George Davidson, of San Francisco. While I was engaged, in 1900–1901, in making a dictionary of Alaskan geographic names, Professor Davidson very kindly placed at my disposal his copy of this scarce atlas, a courtesy for which I here make grateful acknowledgment. Professor Davidson also permitted photographs of it to be made, and accordingly photographs were made of those sheets which specially relate to Alaska. One set of these photographs has been deposited in the Library of Congress, one in the Coast and Geodetic Survey, one in the U. S. Geological Survey, and one in the National Geographic Society.

On account of the rarity of this atlas and its importance for the history of Alaskan exploration and survey, it has seemed worth while to translate and publish a table of its contents. The atlas itself, Professor Davidson's copy, contains no table of contents, and it is therefore uncertain whether any was published. The following table is made up from the sheets themselves, the entries being translations of the titles engraved upon the sheets:

TABLE OF CONTENTS OF SARICHEF'S ATLAS, 1826

Title-page. Atlas of the northern part of the Pacific Ocean, compiled in sheets by the Imperial Navy Department from the latest information and maps, 1826, under the direction of Vice-Admiral and Hydrographer Sarichef I. Engraved and printed at the Hydrographic Office.

Sheet 1. Mercator's chart of the Pacific Ocean and part of the Arctic Ocean.

Sheet 2. Mercator's chart of the Okhotsk Sea and part of the Pacific Ocean, together with Kamchatka between latitude 46° 30′ and 62° 30′ north, longitude 104° and 144° 30′ [east] from St. Petersburg.

Sheet 3. Mercator's chart of the Pacific Ocean, with the Aleutian Islands and parts of northwestern America, from latitude 47° 30′ to 62° 00′ north, longitude 141° 30′ to 179° 00′ east from St. Petersburg. Corrected from reports of Pilot Vasilief, obtained in 1829 on the coast of America from the Kuskokwim River to Fort Alexander.

Sheet 4. Mercator's chart of Bering Strait, with parts of the Pacific Ocean and Polar Sea from latitude 60° to 68° north, longitude 140° to 169° east from St. Petersburg.

Sheet 5. Mercator's chart of a part of the Pacific Ocean, together with northwest America between De Fuca Strait and Kenai Gulf (Cook Inlet), from latitude 48° to 62° north, longitude 174° to 209° east from St. Petersburg.

Sheet 6. Mercator's chart of a part of the Pacific Ocean, together with northwest America between the Bay of Panama and Fuca Strait from latitude 5° to 50° north, longitude 175° to 250° east from St. Petersburg.

Sheet 7. Mercator's chart of the Sandwich Islands from latitude 19° to 25° north, longitude 164° to 174° 50′ east from St. Petersburg.

Sheet 8. Mercator's chart of the New Philippines or Caroline Islands from latitude 5° to 30° north, longitude 106° to 144° east from St. Petersburg.

Sheet 9. Mercator's chart of the Japan and Yellow Seas, with parts of the Pacific Ocean, together with the coasts of China and Japan, from latitude 18° to 47° north, longitude 75° to 125° east from St. Petersburg.

Sheet 10. Contains four plans, as follows:

Northwest Corner.—Plan of the Port of Okhotsk and mouth of the Okhotsk River, with soundings in feet at low water. Drawn with the true compass from reports obtained in 1825. This port is in latitude 59° 20′ 38″ north and in longitude 216° 37′ west from Greenwich. Variation of compass, 1° 30′.

Southwest Corner.—Plan of Feklistof Island and a bay on the west side of it, with soundings expressed in sazhens (Russian fathoms). Compiled from information obtained in 1806 by Borisof, assistant pilot of the fourteenth class. Latitude of the island, 55° 20′ north, longitude 220° 20′ west from Greenwich.

Northeast Corner.—Chart of Aian Bay, situated on the Okhotsk coast west of the River Aldama, with soundings in sazhens. Compiled from information obtained in the year 1806 by Borisof, assistant pilot of the fourteenth class. The latitude of the bay is 56° 27′ 30″ north, longitude 221° 33′ west from Greenwich.

Southeast Corner.—Chart of the bay and of the mouth of the Aldoma River, which empties into it, with soundings expressed in feet. Compiled from information obtained in the year 1793 by Vice-Admiral Fomin. The latitude of the bay is 56° 50′ north, longitude 221° 12′ west from Greenwich.

Sheet 11. Chart of the Gulf of Avacha, together with the harbor of Saints Peter and Paul, which is in latitude 53° 00′ north, longitude 201° 15′ 30″ west from Greenwich. Compiled from information obtained in 1792 by Captain Sarichef. Soundings in sazhens.

This sheet has also a sub-sketch entitled:

"Plan of the harbor of Saints Peter and Paul, with the settlement indicated." Soundings in sazhens.

Sheet 12. Contains four plans, as follows:

Northwest Corner.—Chart of Mechigme Bay, situated at Bering Strait, in Chukotskoi Land. Mechigme settlement is in latitude 65° 27′ 30″ north, longitude 172° 18′ west from Greenwich. From the chart of Captain Billings, 1791. Soundings in sazhens.

Southwest Corner.—Chart of Akomten and Tekerki Bays, situated on the eastern coast of Kamchatka, at a distance of 38½ versts (about 25 miles) to the west of Avacha Bay. Latitude of the bay, 52° 31′ north, longitude 201° 25′ west from Greenwich. Drawn up from reports of Geodesist Sergeant Hilef in 1789. Soundings in sazhens.

Northeast Corner.—Chart of St. Lawrence Bay, situated at Bering Strait, in Chukotski Land. Latitude of the anchoring place, 65° 39′ 33″ north, longitude 171° 11′ 35″ west from Greenwich. Soundings in sazhens. Taken from the chart of Lieutenant Kotzebue.

Southeast Corner.—Chart of Naashkin and Ipadin Bays, situated on the east coast of Kamchatka, at a distance of 28 versts (about 18 miles) to the west of Avacha Bay. Latitude of the bay, 52° 38′ north, longitude 201° 25′ west from Greenwich. Compiled from reports of Geodesist Sergeant Hilef, 1789. Soundings in sazhens.

Sheet 13. Contains four plans, as follows:

Northwest Corner.—Chart of Korovinski Bay, situated on the northwestern coast of Atka Island, in latitude 52° 25′ north, longitude 174° 10′ west from Greenwich. From the chart of Vasilief.

[Scale, 1¾ nautical miles to 1 inch, or 1 : 127000.]

Southwest Corner.—Chart of Attu Island, with indications of a harbor under the designation Ubiennoi (Massacre), which is situated in latitude 53° north, longitude 186° 40′ west from Greenwich. From the chart of Captain Golofnin.

[Scale. 3⅛ nautical miles to 1 inch, or 1 : 228000.]

Northeast Corner.—Chart of Tanaga Bay, situated on the western shore of Tanaga Island. Latitude of the anchoring place, 51° 52′ north, longitude 178° west from Greenwich. Variation of the compass, 16° 34′ east. Soundings in sazhens. From the chart of Sarichef.

[Scale, $\frac{13}{16}$ nautical mile to 1 inch, or 1 : 59000.]

Southeast Corner.—Chart of Massacre Harbor, situated on the southeastern coast of Attu Island, in latitude 53° north, longitude 186° 40′ west from Greenwich. Soundings in sazhens. Variation of the compass, 10° 45′ east. From the chart of Bieliaef.

[Scale, 0.46 nautical mile to 1 inch, or 1 : 33000.]

Sheet 14. Chart of the Aleutian Island Unalaska, together with the bays contained in it, with soundings in sazhens; also anchoring places. From the reports and compilations of Fleet Captain Sarichef in the year 1792.

[Scale, 2 nautical miles to 1 inch, or 1 : 146000.]

Sheet 15. Contains four plans, as follows:

Northwest Corner.—Plan of Chernofski Bay, situated in the western part of Unalaska Island, in latitude 53° 29′ north, longitude 167° 23′ west from Greenwich. Drawn from information by Fleet Captain Sarichef in 1792. Soundings in sazhens.

[Scale, 280 sazhens to 1 inch, or 1 : 23500.]

Southwest Corner.—Plan of Kuliliak Bay, situated in the western part of Unalaska Island, in latitude 53° 31′ north, longitude 166° 57′ west from Greenwich. Made from information obtained by Fleet Captain Sarichef in 1792. Soundings in sazhens.

[Scale, 175 sazhens to 1 inch, or 1 : 14700.]

Northeast Corner.—Plan of Captain Harbor, situated in the northern part of Unalaska Island, with adjacent places east and west, as well as the anchoring place and settlement of Iliuliuk, of which the latitude is 53° 55′ north, longitude 166° 43′ west from Greenwich. Variation of the compass, 19° 24′ east. Drawn from the chart of Lieutenant Kotzebue.

[Scale, 1⅙ nautical miles to one inch, or 1 : 85000.]

Southeast Corner.—Plan of Udagak Strait, between Unalaska and Spirkin Islands. The cape at eastern Beaver Village is in latitude 52° 58′ north, longitude 166° 29′ west from Greenwich. Drawn from information obtained by Fleet Captain Sarichef in 1792. Soundings in sazhens.

[Scale, 0.97 nautical mile to 1 inch, or 1: 71000.]

Sheet 16. Chart of Chiniatski Bay, situated in the Island of Kadiak, with the entrance to Paul Harbor and the settlement of the Russian American Company, of which the latitude is 57° 47′ 10″ north, longitude 152° 18′ 18″ west from Greenwich. Soundings in sazhens. Compiled from reports obtained in the years 1808, 1809, and 1810 by naval officers formerly stationed there.

[Scale, ⅞ nautical mile to 1 inch, or 1 : 64000.]

This chart has a sub-sketch of St. Paul Harbor entitled :

"Plan of Paul Harbor and the Russian American Company's settlement, situated upon it, on the Island of Kadiak."

[Scale, 60 sazhens to 1 inch, or 1 : 5000].

Sheet 17. Contains four plans (and a sub-sketch), as follows :

Northwest Corner.—Chart of Port Chatham, situated in the entrance to Kenai Gulf (Cook Inlet), on the northwestern shore of America. Roadstead, in latitude 59° 14′ 00″ north, longitude 151° 40′ west from Greenwich. Variation of the compass, 24° east. Soundings in sazhens. From the chart of Vancouver.

[Scale, $\frac{15}{16}$ nautical mile to 1 inch, or 1 : 68000.]

Southwest Corner.—Chart of the northwestern part of the Island of Khatagaluk and Nuchek Gulf, situated in latitude 60° 17½′ north, longitude 147° 00′ west from Greenwich. Variation of the compass, 28° 7½′ east. Soundings in sazhens. From the chart of Captain Sarichef.

[Scale, 1⅔ nautical miles to 1 inch, or 1 : 122000.]

Northeast Corner.—Chart of the entrance to Three Saints Harbor, situated in the southeastern part of Kadiak Island. Its latitude is 57° 5′ north, longitude 153° 27′ west from Greenwich. Variation of the compass, 26° east. Soundings in sazhens. From the chart of Captain Sarichef.

[Scale, ⅞ nautical mile to 1 inch, or 1 : 64000.]

Southeast Corner.—Chart of Samganuda Bay, situated in the northeastern part of Unalaska Island. Its latitude is 53° 57′ north, longitude 166° 32′ west from Greenwich. Variation of the compass, 19° east. Soundings in sazhens. From the chart of Captain Sarichef.

[Scale, $\frac{7}{30}$ nautical mile to 1 inch, or 1 : 17000.]

Sheet 18. Contains four plans, as follows:

Northwest Corner.—Chart of the entrance to Port Altorp, in Cross Strait, called by the English Cross Sound, situated in the northern part of Yakobi Island, on the coast of northwestern America. Roadstead's latitude is 58° 12′ 00″ north, longitude 136° 25′ west from Greenwich. Variation of the compass, 30° east. From Vancouver chart.

[Scale, $\frac{11}{30}$ nautical mile to 1 inch, or 1 : 27000.]

Southwest Corner.—Chart of Altua Bay, situated on the coast of northwest America. Place under the letter A is in latitude 58° 37′ north, longitude 137° 31′ west from Greenwich. Variation of the compass, 25° east. Soundings in sazhens. From the chart of La Perouse.

[Scale, $\frac{5}{6}$ nautical mile to 1 inch, or 1 : 61000.]

Northeast Corner.—Chart of Ilin Bay, situated in Yakobi Island, near Sitka Island. Place A is in latitude 57° 47′ 2″ north, longitude 136° 16′ west from Greenwich. Variation of the compass, 22° east. Soundings in sazhens. From the chart of Pilot Ilin.

[Scale, $\frac{7}{36}$ nautical mile to 1 inch, or 1 : 14000.]

Southeast Corner.—Chart of Port Chalmer, situated in the northwestern part of Tsukli Island. Latitude of point A is 60° 15′ 00″ north, longitude 147° 28′ 30″ west from Greenwich. Variation of the compass, 28° 30′ east. Soundings in sazhens. From the chart of Vancouver.

[Scale, $\frac{16}{19}$ nautical mile to 1 inch, or 1 : 61000.]

Sheet 19. Chart of Sitka Bay, situated on the northwest coast of America, with indication of the entrance to the chief settlement of the Russian-American Company, called New Archangel, of which the geographical latitude is 57° 3′ north, longitude 135° 18′ west from Greenwich. Soundings expressed in sazhens. Establishment, 12:30. Rise of water, from 14 to 14½ feet. Compiled from reports obtained by naval officers in 1809.

[Scale, ¾ nautical mile to 1 inch, or 1 : 55000.]

Sheet 20. Contains four plans, as follows:

Northwest Corner.—Plan of Stewart Bay, situated on the northwest coast of America. Latitude of point A, 55° 38′ 15″ north, longitude 131° 47′ west from Greenwich. Variation of the compass, 28° 30′ east. Soundings in sazhens. From the chart of Vancouver.

[Scale, $\frac{16}{19}$ nautical mile to 1 inch, or 1 : 61000.]

Southwest Corner.—Plan of Protection Bay, situated on the northwest coast of America, in Beaver Island. Latitude of Point Baker, 56° 20′ 30″ north, longitude 133° 37′ 30″ west from Greenwich. Variation of the compass, 26° 30′ east. Soundings in sazhens. From the chart of Vancouver.

[Scale, $\frac{32}{35}$ nautical mile to 1 inch, or 1 : 67000.]

Northeast Corner.—Plan of Conclusion Bay, situated at the south point of Sitka Island, on the shore of Northwest America. Latitude of point A is 56° 15′ 00″ north, longitude 134° 40′ west from Greenwich. Variation of the compass, 25° 30′ east. Soundings in sazhens. From the chart of Vancouver.

[Scale, $\frac{6}{19}$ nautical mile to 1 inch, or 1 : 23000.]

Southeast Corner.—Plan of Spaskoi Harbor, situated on the northeastern shore of Yakobi Island. Its latitude is 58° 6′ north, longitude 135° 17′ west from Greenwich. Soundings in sazhens. From the chart of Assistant Pilot Bubnof.

[Scale, $\frac{1}{14}$ nautical mile to 1 inch, or 1 : 5200.]

Sheet 21. Contains four plans, as follows:

Northwest Corner.—Plan of Gray's Harbor, situated on the northwest coast of America. Latitude of point A, 47° 00′ north, longitude 123° 53′ west from Greenwich. Variation of the compass, 18° east. Soundings in sazhens. From the chart of Vancouver.

Southwest Corner.—Chart of Nootka Sound and Bay, situated in Vancouver Island, on the northwest coast of America. Soundings in sazhens. Latitude of point A, 49° 36′ north, longitude 126° 24′ west from Greenwich. Variation of the compass, 17° 49′ east. From the chart of Cook.

Northeast Corner.—Chart of Juan De Fuca Strait and Discovery Harbor, situated in northwest America. Latitude of point A 48° 2′ 30″ north, longitude 122° 37′ 30″ west from Greenwich. Variation of the compass, 21° 30′ east. Soundings in sazhens. From the chart of Vancouver.

Southeast Corner.—Chart of entrance to Bucareli Harbor, situated in Beaver Island on the northwest coast of America. In latitude 55° 15′ north, longitude 133° 35′ west from Greenwich. Soundings in sazhens. From the chart of La Perouse.

Sheet 22. Contains four plans, as follows:

Northwest Corner.—Plan of San Diego Harbor on the shore of northwest America. Latitude of point A, 32° 42′ 30″

north, longitude 117° 1′ 37½″ west from Greenwich. Variation of the compass, 11° east. Soundings in sazhens. From the chart of Vancouver.

Southwest Corner.—Plan of Port San Francisco, situated on the shore of northwest America, northern California. Cape Korolei, in latitude 37° 59′ north, longitude 122° 34′ west from Greenwich. Soundings in sazhens. From the chart of La Perouse.

Northeast Corner.—Plan of Monterey Bay, situated on the coast of northwest America, in northern California, in latitude 36° 38′ north, longitude 121° 34′ west from Greenwich. Soundings in sazhens. From the chart of La Perouse.

Southeast Corner.—Chart of the entrance to Columbia River, on the shore of northwest America. Point A, in latitude 46° 19′ north, longitude 123° 54′ west, from Greenwich. Soundings in sazhens. From the chart of Vancouver.

Sheet 23. Contains three plans, as follows:

Northwest Corner.—Chart of Socoro Island, to the south of Cape California. Latitude of Tent Settlement, on Socoro Island, is 18° 42′ north, longitude 110° 3½′ west from Greenwich. Variation of the compass, 7° east. Soundings in sazhens. From the chart of Arrowsmith.

Southwest Corner.—Chart of strait in Chugach Gulf (Prince William Sound), in the northwestern part of Klikaklik Island, with indications of the anchoring places. Compiled from reports obtained in the year 1790 by Captain Sarichef. Soundings in sazhens. Latitude of point A, 59° 56′ north, longitude 148° 24′ west from Greenwich.

Eastern Half.—Chart of a part of the shore of northwest America from Fort Rose to Big Bodega Cape, with Count Rumiantsof Bay. Latitude of anchoring place, 38° 18′ 30″ north, longitude 122° 35′ west from Greenwich. Soundings in sazhens at low water. Variation of the compass, 16° east. From the chart of Captain Hagenmeister.

Sheet 24. Contains three plans, as follows:

Western Half.—Chart of Manila Bay, in Luzon Island, situated on the border of the Philippine Islands. Latitude of Manila City, 14° 36′ 00″ north, longitude 239° 2′ 22″ west from Greenwich. Soundings in sazhens. From a Spanish chart made in 1792.

Northeast Corner.—Chart of Maribelski Harbor, situated on the border of the Philippine Islands, in Luzon Island, at the entrance to Manila Bay, on the northern side. Latitude of Maribel Village, 14° 26′ 15″ north, longitude 239° 31′ 30″ west, from Greenwich. Soundings in sazhens. From a Spanish chart made in 1792,

Southeast Corner.—Chart of Cavite Harbor, situated within Manila Bay. Latitude of eastern corner of the fort, 14° 29′ 20″ north, longitude 239° 5′ 40″ west from Greenwich. Soundings in sazhens. From a Spanish chart made in 1792.

Sheet 25. Contains three plans, as follows:

Northwest Corner.—Chart of Kastri Bay (De Castries), situated on the western coast of Tartary, in latitude 51° 29′ north, longitude 218° 57′ west from Greenwich. Soundings in sazhens. From the atlas made by La Perouse.

Southwest Corner.—Chart of Inner Harbor and Macao Roads, situated on the coast of China, of which the latitude is 22° 11′ 20″ north, longitude 246° 29′ west from Greenwich. Soundings in sazhens. From the chart of Arrowsmith.

Eastern Half.—Chart of the Chinese coast from Morskoi Gulf, or Ti-po-hoi, to Tikam Island. Soundings in sazhens. From the chart of Arrowsmith, published in 1812.

Sheet 26. Contains four plans, as follows:

Northwest Corner.—Chart of Brotonof Harbor, situated in the northern part of the chain of the Kurile Islands, of which the latitude is 47° 8′ north, longitude 208° 2′ 30″ west from Greenwich. Soundings in sazhens. From the chart of Golofnin.

Southwest Corner.—Chart of the eastern part of Yesso Island from Nosteki Bay to Atkis Bay, of which the latitude is 43° 25′ north, longitude 214° 17′ west from Greenwich. From the chart of Krusenstern.

Northeast Corner.—Chart of a harbor in the eastern part of the Kurile Island Urupa, in latitude 45° 56′ 29″ north, longitude 209° 45′ 37″ west from Greenwich. Soundings in sazhens. From the chart of Captain Golofnin.

Southeast Corner.—Chart of Nangasaki Bay, situated in Kiuziu, one of the Japanese Islands. Latitude of Megaski, 32° 44′ 50″ north, longitude 230° 7′ 20″ west from Greenwich. Variation of the compass, 1° 45′ 30″ west. Soundings in sazhens. From the chart of Captain Krusenstern.

Sheets 27–33. Entitled, "View of the shores and islands situated in Okhotsk Sea and in parts of the Pacific Ocean."

MAGNETIC SURVEY OF THE UNITED STATES*

BY DR. L. A. BAUER, CHIEF OF DIVISION OF TERRESTRIAL MAGNETISM, COAST AND GEODETIC SURVEY

IN the "Plan for the Reorganization of the Survey of the Coast, as adopted by a board convened on the 30th of March, 1843, by direction of the President of the United States," explicit provision is made for the making of "all such magnetic observations as circumstances and the state of the annual appropriations may allow." Since then Congress, by more or less generous appropriations, has distinctly recognized the importance of this feature of the work of the Survey.

Under the first Superintendent, Prof. F. R. Hassler, the magnetic declination ("variation") was supplied on the Coast Survey Charts, as determined with the aid of the ordinary nautical instrumental means then in vogue.

The real magnetic work of the Survey, however, may be said to have commenced with Professor Hassler's successor, Prof. Alexander Dallas Bache. Professor Bache had previously made a magnetic survey of Pennsylvania, which was not followed until in quite recent years by the magnetic surveys of Missouri, New Jersey, Maryland, and North Carolina. He had likewise established the first magnetic observatory in this country—that at Girard College, Philadelphia—and, while on a trip abroad, had made a series of magnetic observations at various places.

Improved magnetic instruments were now imported, and the expert aid of Dr. John Locke, of Cincinnati, and Professor Renwick, of Columbia College, was temporarily employed. The three magnetic elements—declination, dip, and intensity—were determined at various places, chiefly along the sea coast.

The work of magnetic observation, thus fairly started, has since been prosecuted without interruption over the entire country, including Alaska and the Hawaiian Islands, as well as in some foreign countries, by various members of the Survey.

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*Abstract of an address before National Geographic Society January 24, 1902.

With the advancing years the demands for practical information from surveyors and mariners became so heavy that on July 1, 1899, there was created a special division, known as the "Division of Terrestrial Magnetism."

The magnetic work has thus been made one of the fundamental divisions of the work of the Survey, and it is now possible to undertake seriously a magnetic survey of the United States and countries under its jurisdiction according to the methods in use in similar undertakings abroad. Nearly every civilized country is at present either planning or has already carried out a detailed magnetic survey of its dominions.

OBJECTS OF A MAGNETIC SURVEY

A magnetic needle or compass does not point "true to the Pole," as the old saying would have it, and as was discovered by Columbus on September 13, 1492, but instead makes an angle with the true north and south line, this angle being anything you please, according to the location of the place where the compass is mounted. Thus, in the United States, in the extreme northeastern part of Maine, a compass points 21 degrees west of north, while in the northwestern part of the state of Washington it points 23 degrees east of north; hence a change of 44 degrees from one end of our country to the other. There are portions of the earth where the "north" end of the needle points due east or due west, and even for a place between the magnetic North Pole and the geographical North Pole due south.

In view then of the fact of the use of the compass by the surveyor to locate land surveys, by the mariner to guide him in storm and night, over trackless seas, and by the traveler to pilot him in unfrequented regions of the earth, it becomes the first object of magnetic surveys to determine the amount by which the compass direction differs from the true direction, and to publish the quantities in such a form so that those interested may, at a glance, be able to extract the desired information. The chart of lines of equal magnetic declination in the United States for 1900, based on over 4,000 determinations in different parts of the country, is a specimen of the form now generally adopted for giving this information in a convenient form. At the places along any one line, *e. g.*, the line marked 8 degrees east, passing through about the central part of the United States, the needle everywhere points 8 degrees east. Along the line marked zero, passing near Columbus, Ohio, and Columbia, South Carolina, the compass direction coincides with the true direction and the needle is "true to the Pole," etc.

Next, attention is called to the fact that such a chart can only apply to a certain year—thus our present chart is for January 1, 1900—namely, not only does the needle not generally point due north, as already shown, but the amount of the angle by which it departs therefrom is continually undergoing change, during the day, during the month, and from year to year. Thus, at London, for example, the needle changed its direction from 11¼ degrees east in 1580 to 24 degrees 12 minutes west in 1812, a change of 35 degrees in 232 years. A street a mile long, laid out in London during the year 1580, in the direction of the compass at that time, would have its northerly terminus by seven-tenths of a mile too far east, according to the compass direction of 1812. At the present time the needle points about 16½ degrees west at London.

In this country the rate of change in the compass direction is not as large as at London, but nevertheless of sufficient magnitude to seriously affect the magnetic bearings of boundary lines. Thus, at Baltimore the needle pointed in 1670 about 6 degrees and 6 minutes west; in

1802, 39 minutes west, and in 1900, 5 degrees west. A street laid out in Baltimore in 1670 so as to run parallel to the compass direction prevailing at that time would have its north terminus one-tenth of a mile too far west in 1802.

This change in the compass direction, known as its *secular change*, was discovered by Gellibrand, an English mathematician, in 1634.

Even in the course of a day the fitful needle changes its direction by an amount sufficient to be taken into account. This amount, according to the season of the year, may cause a discrepancy of from 5 to 20 feet at the terminus of a line a mile long run by the compass in the morning and re-run in the afternoon.

Again, at times the needle's direction, by some subtle force, is abruptly changed out of its course. This is the case during magnetic storms which make their influence felt over a very large portion of the globe at practically the same instant of time. Thus, in November, 1882, during the period of maximum number of sun spots, occurred a magnetic storm which caused the needle at Los Angeles, California, to change its direction by more than a degree and a third. At the same time General Greely, at Lady Franklin Bay, in the Arctic region, noted a deflection of 20 degrees and 48 minutes. Frequently these magnetic storms are accompanied by brilliant displays of polar lights.

There are, in addition, many minor fluctuations, depending upon the position of the sun and the moon with reference to the earth and to each other.

We can follow with our eyes the sun in its apparent motion around the earth, and can behold many of the manifold changes ever taking place in our starry firmament, but here is something in the earth, invisible to us, that we call magnetism, which day by day, year in, year out, passes through its cycle of changes—a force powerful enough to bend every bit of magnetized steel out of its regular course and to compel the needle to march in perfect obedience to its will!

We thus see that it is possible to portray the state of the earth's magnetic condition, as represented by magnetic maps, only for a definite moment of time. The tides, the trade winds, while subject to definite periodic fluctuations, nevertheless will not change their general character for thousands of years, but a few years suffice to materially change and make useless a cartographical representation of the magnetic lines.

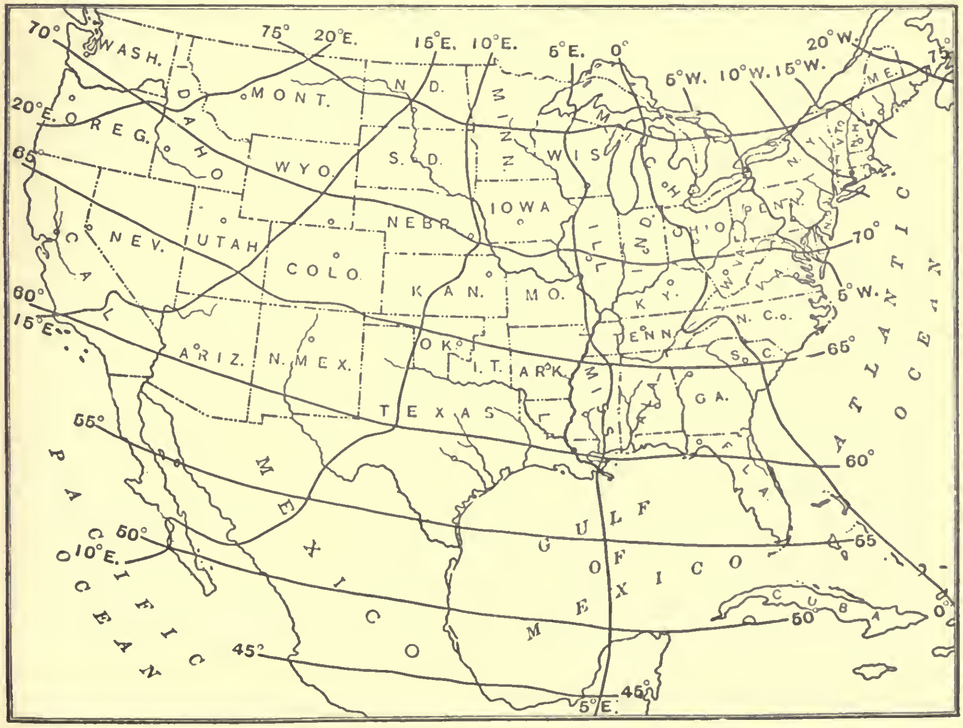
The second great object of a magnetic survey must, therefore, be to provide such means, in order that a continuous record be obtained of the countless fluctuations and vagaries of the magnetic needle. It is then possible to always bring our magnetic charts up to date, and to provide the surveyor and mariner with the precise amount of change between any two given dates.

The Coast and Geodetic Survey has made an exhaustive and careful compilation of all the available data for the past three centuries as obtained from various sources, and the practical information which it is in the position to furnish in reference to inquiries from lawyer and surveyor is regarded as final and authoritative throughout the country. The amount of money saved to land-owners in the prevention of costly litigations by the information thus furnished exceeds many times the total amount spent by the government for magnetic work.

Furthermore, in connection with the magnetic survey, certain base stations are established, where are erected magnetic observatories, in which are mounted sensitive magnetic instruments, recording photographically, day and night, the variations or changes of the magnetic needle. Such a station has been established 16 miles southeast of the city of Washington, at Cheltenham, Maryland, far removed from artificial disturbing influences, such as electric car lines, whose powerful influence may affect magnetic instruments five miles away. Similar stations have also been established at Baldwin, near Lawrence, Kansas; at Sitka, Alaska, and near Honolulu, in the Hawaiian Islands, in order to assist in the magnetic survey of those regions. All of these observatories are furthermore taking part in the international magnetic work conducted in coöperation with the present Arctic and Antarctic Expeditions.

The practical application of magnetic data is, however, not entirely limited to a knowledge of the direction of the compass needle. The mariner, with the modern iron ship now in use, carries with him a continuous source of disturbance, so that his uncompensated compass will fail to give even the true magnetic direction for the ship's position. It is therefore necessary to apply such counteracting or correcting devices which will annul to a large extent the ship's magnetic influence. These mechanical devices are not, however, entirely compensatory for all the places a ship is likely to be in, owing to the changing character of the ship's own magnetism, and so the mariner must determine a table of correction (the so-called deviation table) for the different positions and directions of the ship's head. For this purpose a knowledge of the dip of the magnetic needle (the angle by which a magnetic needle mounted in the vertical plane passing through the magnetic meridian is pulled down by the earth's magnetic force) and the intensity of the magnetic force are essential. The electrician, the geologist, and the physicist likewise desire a knowledge of these quantities. They are furthermore essential in ascertaining the precise laws underlying the variations of the earth's magnetism.

A complete magnetic survey, therefore, embraces the determinations of the three magnetic elements, magnetic declination (variation of the compass), dip, and intensity, and their changes from time to time.



Lines of Equal Magnetic Declination (Variation of the Compass) and Equal Magnetic Dip for the Year 1900

SVEN HEDIN IN TIBET

MR. JOHN B. JACKSON, Secretary of the United States Embassy at Berlin, sends to this Magazine an abstract of a letter from Sven Hedin to King Oscar of Sweden, describing Sven Hedin's march across Tibet. The letter is dated at Leh, India, December 20, 1901, and was received at Stockholm late in January of this year. During the last three years that he has been in Asia, Sven Hedin has explored and mapped six thousand miles of territory previously unknown to civilization. He has taken over 4,000 photographs and sketches. This expedition, in its results, is the most important he has ever made, and marks him as one of the most dauntless, accurate, and original explorers of history. Before the publication of the more scientific results of his journey he will write a large book for the public describing his travels. An account of his work during the first two years of the expedition appeared on page 393, volume xii, of this Magazine.

Dr. Sven Hedin left his headquarters in northern Tibet July 27, 1901, and, disguised as a Buryat and accompanied only by Lama, a Mongolian belonging to the caravan, also disguised as a Buryat, set out on his march to the south. They carried only absolute necessities, but when two days out were attacked by robbers and relieved of various articles besides their two best horses. This taught them the need of night watches, so they took turns in watching every night three hours at a time, which was a hardship, for it was the rainy season, and it poured. The further south they went the more wet it became, until at last the ground was little better than a deep morass, which threatened to engulf them. But they worked through, and at last reached inhabited land, where the black tents of the nomads greeted them and the rich grass promised fine feed for their cattle. Lama was able to communicate with these nomads, and was shown the way toward Lhasa.

They went on for two hard days' marches, when one evening they were suddenly halted by some native chiefs. Three soldiers appeared before their tents and informed them shortly that they were to consider themselves prisoners and forbidden to attempt to escape under penalty of death. They were very well treated, however. Everything they required was supplied, but they were kept in ignorance of what was to become of them pending the arrival of the "banbo," the governor of the province, who had been notified of their capture, and who would on his arrival decide what was to be done with them. Meanwhile their anxiety was increased by the departure of a large force, fully armed, back on the track, and they feared that an attack on their headquarters was contemplated. Finally the banbo arrived, and word was sent to Hedin that he would receive him. To this Hedin replied that he had no special desire to see him, but that if his excellency desired to meet him he was always to be found in his tent! The result was that the governor, accompanied by 67 chiefs and courier soldiers, appeared at his tent, gorgeously apparelled. They informed Hedin that he was known to be an Englishman, and that it was impossible to allow him to proceed to Lhasa. He was also informed that they were aware that he had a large caravan in the north, which was attempting to enter his province of Nokktgin, and accordingly all northern entrances were strongly guarded. The banbo then gave Hedin presents of horses, sheep, etc., and returned him to the border as a prisoner of war under guard of 20 soldiers.

They reached their caravan on the

28th of August, very thankful to have escaped so easily, and found all in good order. After necessary rest the whole caravan continued its way in a southwesterly direction, determined to keep on their course until stopped again by the Tibetans. This happened in a short time, on the east side of the Naaksang-Tfo Lake, where an embassy from Lhasa stopped them. It was 300 riders strong, heavily armed with guns, swords, and pikes. He asked them what would happen if in spite of their command he insisted on pushing to the south. "We will fire upon the caravan," was the steady reply. He attempted to make it clear to the good people that each of his forces could easily dispose of at least 36 Tibetans, and that their fire would be of no great danger to them. The chief considered on this argument that it would be as well for both parties to attempt to come to some understanding without shooting. Hedin then continued on the march in a westerly direction, being accompanied in good-fellowship by the Tibetan guard. Near Tyargutso the troops were augmented by 500 riders, and it was not for several weeks that they became convinced that Hedin and his party did not intend to profane their holy city, and the stately cavalcade left them to pursue their way alone to Panggong and Leh, where they arrived in good condition on the morning of the 20th of December, 1901.

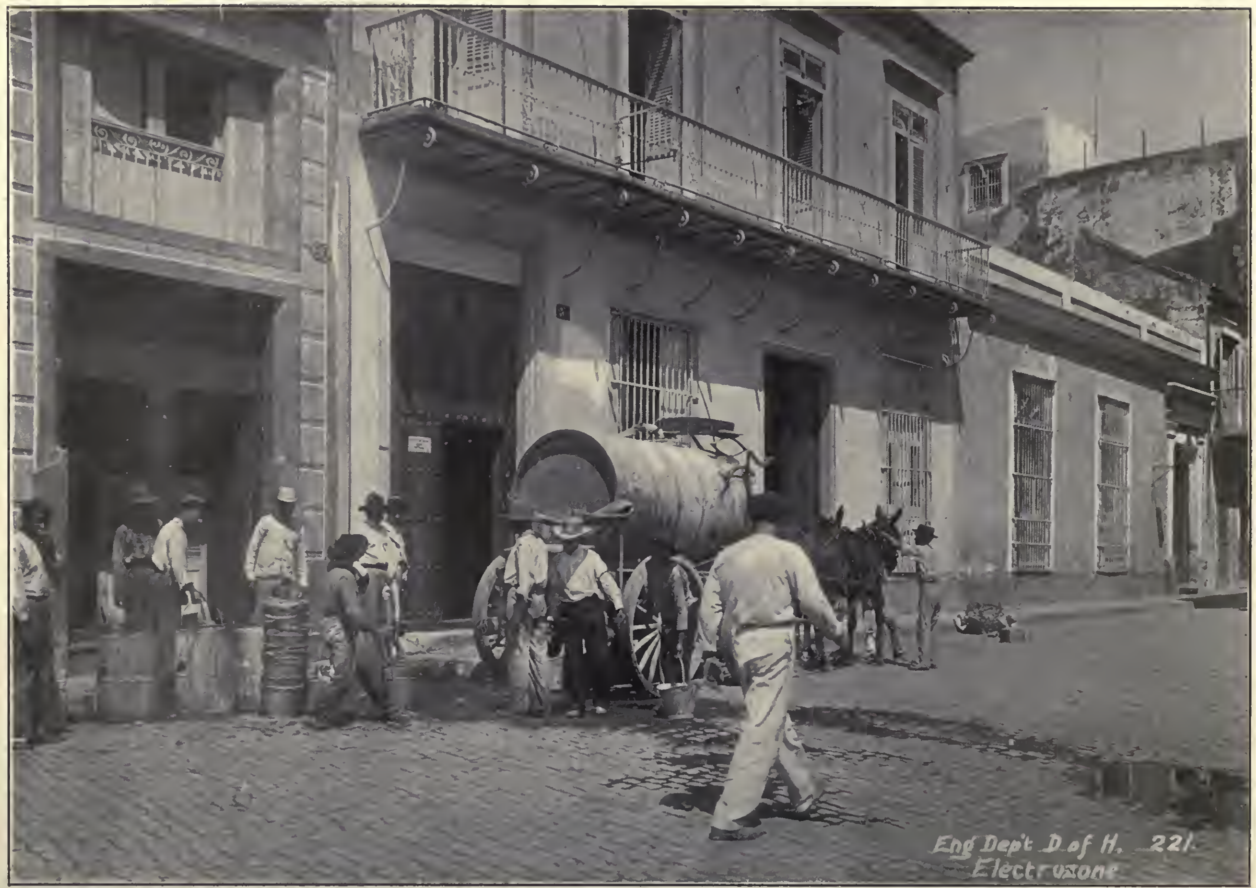
AMERICAN PROGRESS IN HABANA

THE city of Habana has so long been considered as a sort of nursery of diseases for the United States that the average American citizen finds it hard to realize that today Habana is clear and pure, more healthy than Washington and many cities on the American continent. Unenviable has been the record of the Cuban capital; yellow fever, typhoid fever, and filth diseases have found a luxurious home there for one hundred years. In 1896 1,262 deaths from yellow fever alone were reported by the city government. In 1899, the year of least yellow fever during eleven years, 1889–1899, 101 persons died in Habana with the dreaded pest. The average for the eleven years was 440 fatal cases. In 1901, for the first time in the history of the city, the yellow fever season—April 1 to January 1—has passed with only five fatal cases of the disease occurring. October, November, and December, 1901, the months during which the fever was wont to play the fastest, each came and went without a single case.

The wise, conscientious, persistent measures which for three years the United States officers have been enforcing throughout Habana, despite the opposition and dislike of the Cubans, have delivered the city of its old foes—filth and filth diseases.

The illustrations that accompany this brief paper show strikingly the contrast between Habana of the past and Habana of today. The pictures were loaned to this Magazine by Major Wm. M. Black, of the Engineer Corps of the U. S. Army. On the United States occupation of Habana, January, 1899, to Major Black was given charge of the engineering work of the city, and to him are due in large measure the splendid results that have been achieved. His courageous and broad-minded enthusiasm overcame prejudice and opposition and found inexpensive methods of accomplishing tasks which were thought impracticable because of their supposed cost.

By the end of the second year of American occupation every house in

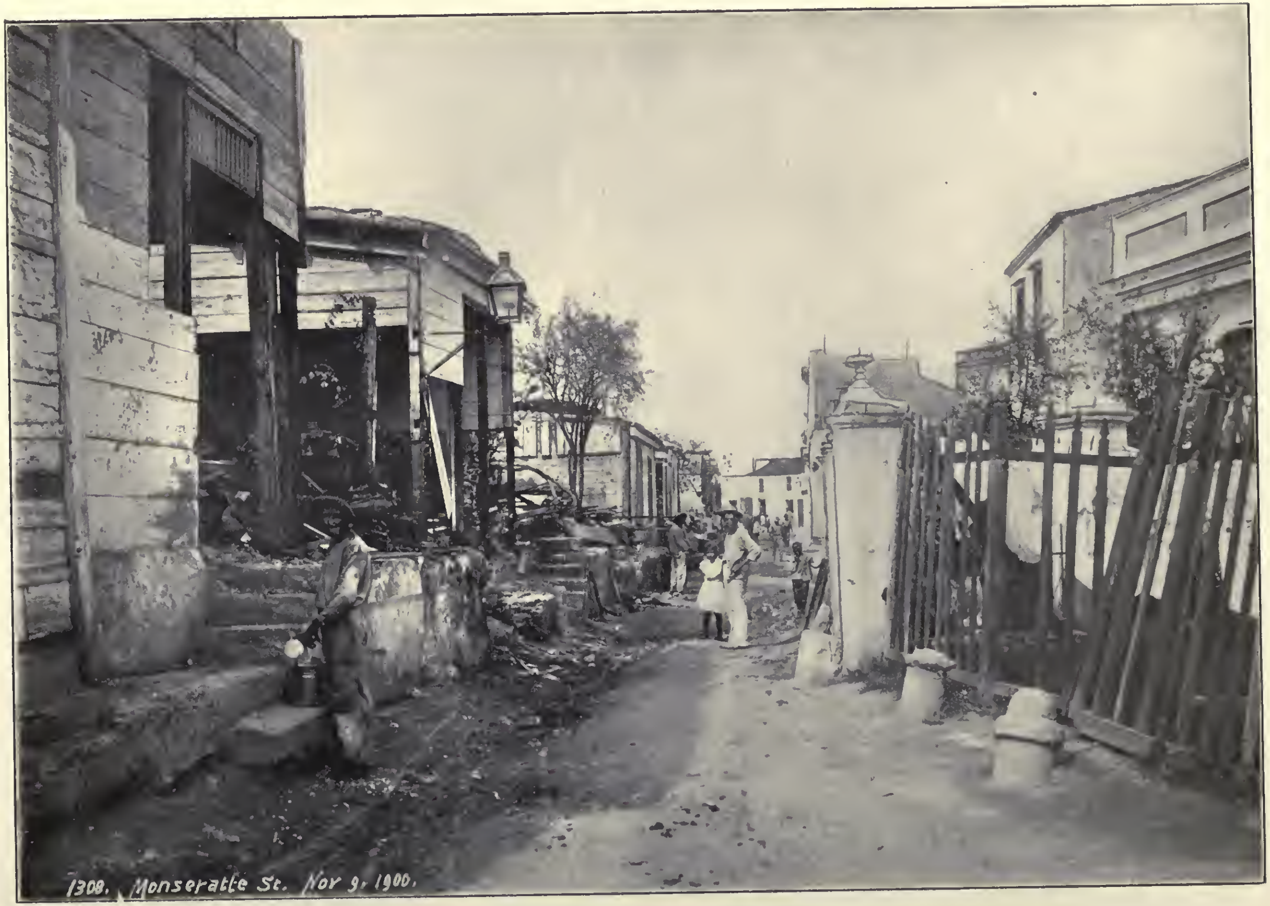


No. 1. Cleaning Houses on Officios Street, Habana

the city had been cleaned from top to bottom at least once under the supervision of American officers. Picture No. 1 shows the cleaning squad in front of a house which was about to be attacked. The squad washed the floors with electrozone (made by the electrolysis of sea water) and the walls with a solution of bichloride of mercury. As many as 16,000 houses were cleaned in this way in a single month. When the squad left a house it was as clean and spotless as "Spotless Town." All this cleansing was done by hired Cubans under the personal direction of an American officer. The Cuban of high or low degree had to have his house purified, and his remonstrances availed nothing. It may at first sight seem to have been an arbitrary course of proceedings, to enter a man's house thus and wash it while he and his family looked on, but the health and safety of the whole people demanded that a complete cleansing of the city be made. The sights that met the cleaning squad may be imagined but not described. Accumulations of years and decades of filth were heaped in cellars and courts and closets.

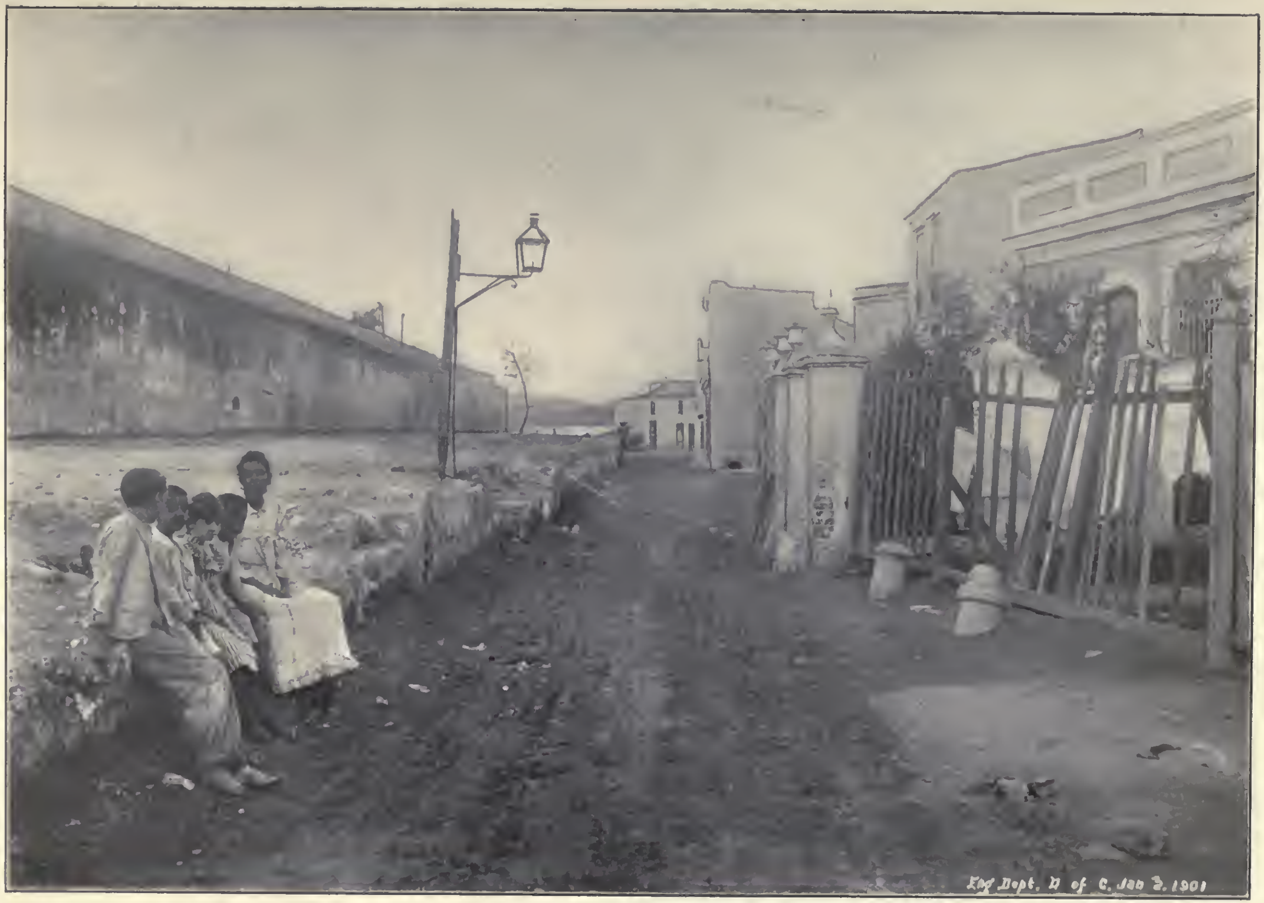
The cleaning of the houses, however, was not a circumstance to the work of opening and cleaning the sewers. These had not been touched since they were built, long ago. Years of refuse had choked many of them, so that the system had become a continual source of danger to the city. Without hesitation, however, they were attacked by the energetic squads and every foot of sewer thoroughly cleansed and repaired. So scientifically was the work done that, though the men were working deep down in the ground all day long, not a single man of the squads was taken sick.

No. 2. Hospital Militar, Habana



No. 3. Before American Occupation

The wretched shanties on the left were breeding dens of disease



No. 4. After American Occupation

The shanties have been cleared away

No. 5. A Section of the Colon Park, Habana, when the United States Officers Assumed Control of the City

When the United States troops entered Habana the building shown in picture No. 2, though intended for a hospital, was notorious as probably the most vile building hygienically in the world. Between 60 and 70 per cent of the patients carried there died within its walls. Even the American doctors shunned the place, and soldiers passing literally held their breath. The first thing the American officers did was to cleanse it from top to bottom; then they put several thick coats of whitewash on its walls, and made the building, which is as large as two city blocks, as spick and span as a Yankee kitchen. The hospital is now used as a school-house for 700 children. The top floor has been remodeled into school-rooms, and furnished throughout with the latest American improvements. A gymnasium, with a complete equipment, was added, and the basement turned into a warehouse. Today there is not a healthier spot in Habana than this building, which for years had been a hot-house of vice and disease.

The hovels on the left, in picture No. 3, were formerly breeding dens of disease. They had been built on public parking by some investor who had bribed the Spanish officials to overlook his appropriation of public property. The miserable huts were crowded with the refuse of humanity, and the investor and disease had reaped equally rich harvests. One of the first things the new administration did was to tear down the row. Picture No. 4 shows the transformation. The high wall on the left is a part of the old city wall, of which only this small section remains.

No. 6. The Same Section of the Colon Park a Few Months Later

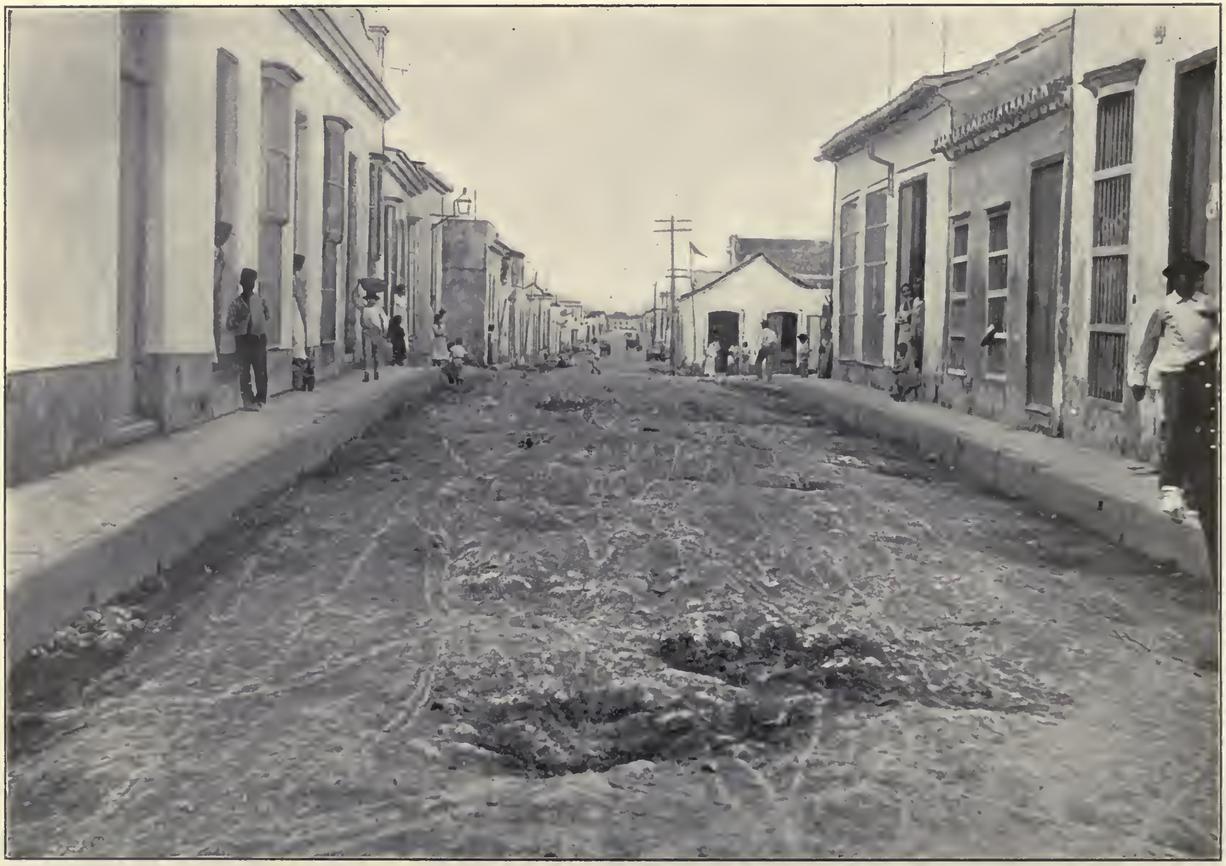
The parking inside the wall belongs to the people.

The former condition of Colon Park is shown by picture No. 5. The park had run to weeds and coarse grass. It was not only unattractive because of its general untidiness, but quite unsafe for women and children. At night-time it was haunted by thieves and thugs. To pass by after dark was to risk being held up and robbed of one's purse or even of one's clothes.

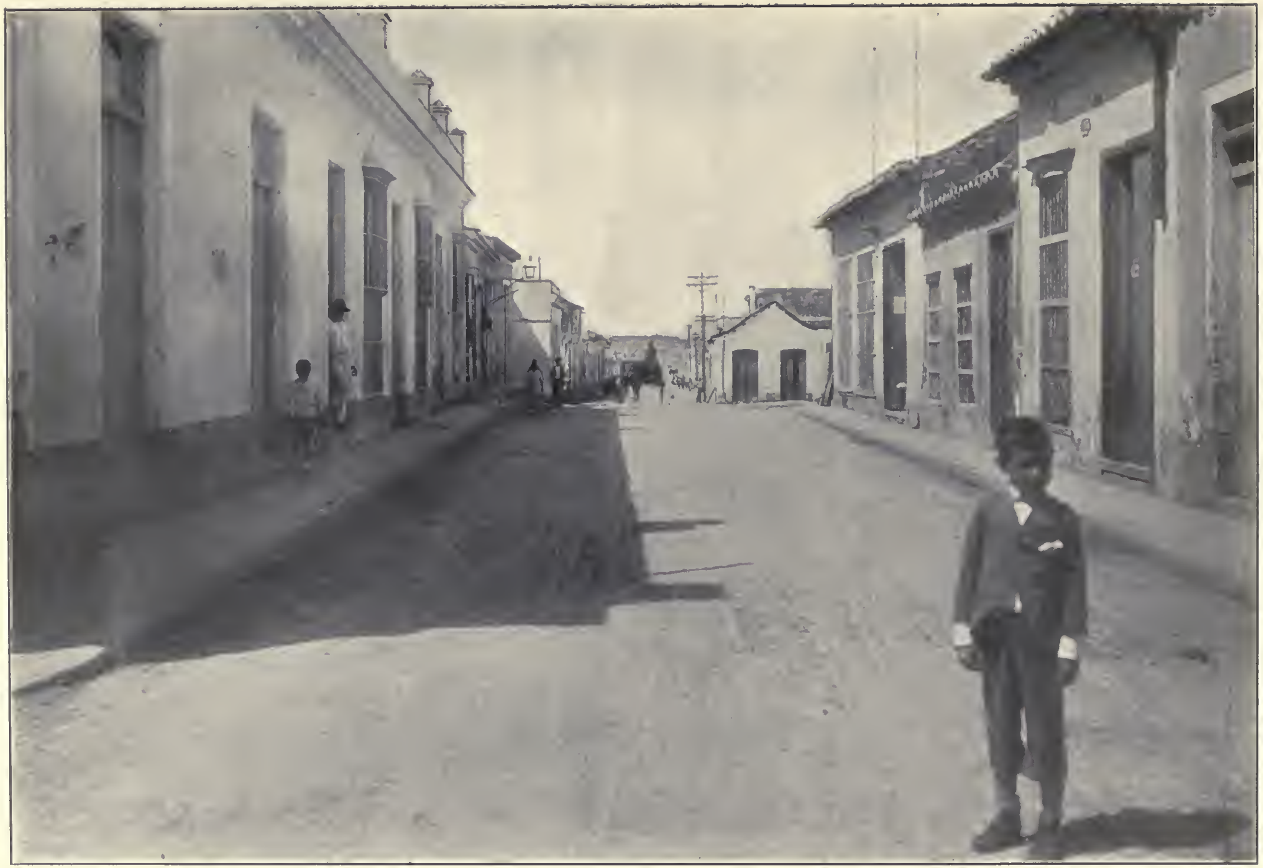
Today the park is one of the pleasure spots of Habana. Children and nurse girls throng the walks in the daytime. In the evening it is a popular promenade for the people. The walks have been cleaned, the grass and trees trimmed, new trees and shrubs planted, benches have been placed under the trees, and at night-time electric lamps keep the park bright and safe.

Picture No. 7 represents a typical street of Habana in 1898. This street was then regarded as quite a good one. Picture No. 8 shows the same street after the American officers had been in the city a few months. The holes and stones have disappeared and in their stead is a hard, smooth, well-drained way. One hundred and twelve miles of streets in Habana and its suburbs have undergone this transformation. The width of the streets ranges from 4.4 meters to 13 meters.

The engineers had a problem on their hands to remake such narrow thoroughfares without blocking the traffic, but they solved the problem, and the work progressed rapidly without interruption to the stream of carts and vehicles. During the repairing of one street, which was only 4.4 meters wide, between the hours of 6 a. m. and 6 p. m. Major



No. 7. A Street in Habana Before United States Occupation



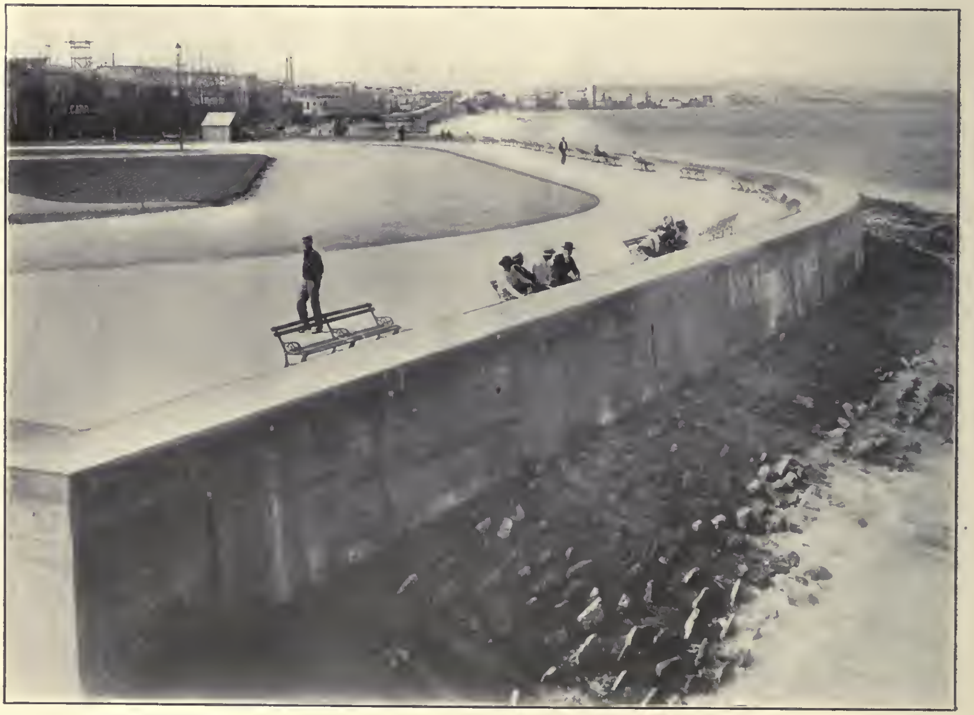
No. 8. The Same Street After Twelve Months of United States Occupation

Black counted 2,371 vehicles passing one point; during the busiest part of the day 324 passed in a single hour. On another street, 6 meters wide, 2,500 vehicles passed a certain point in one working day.

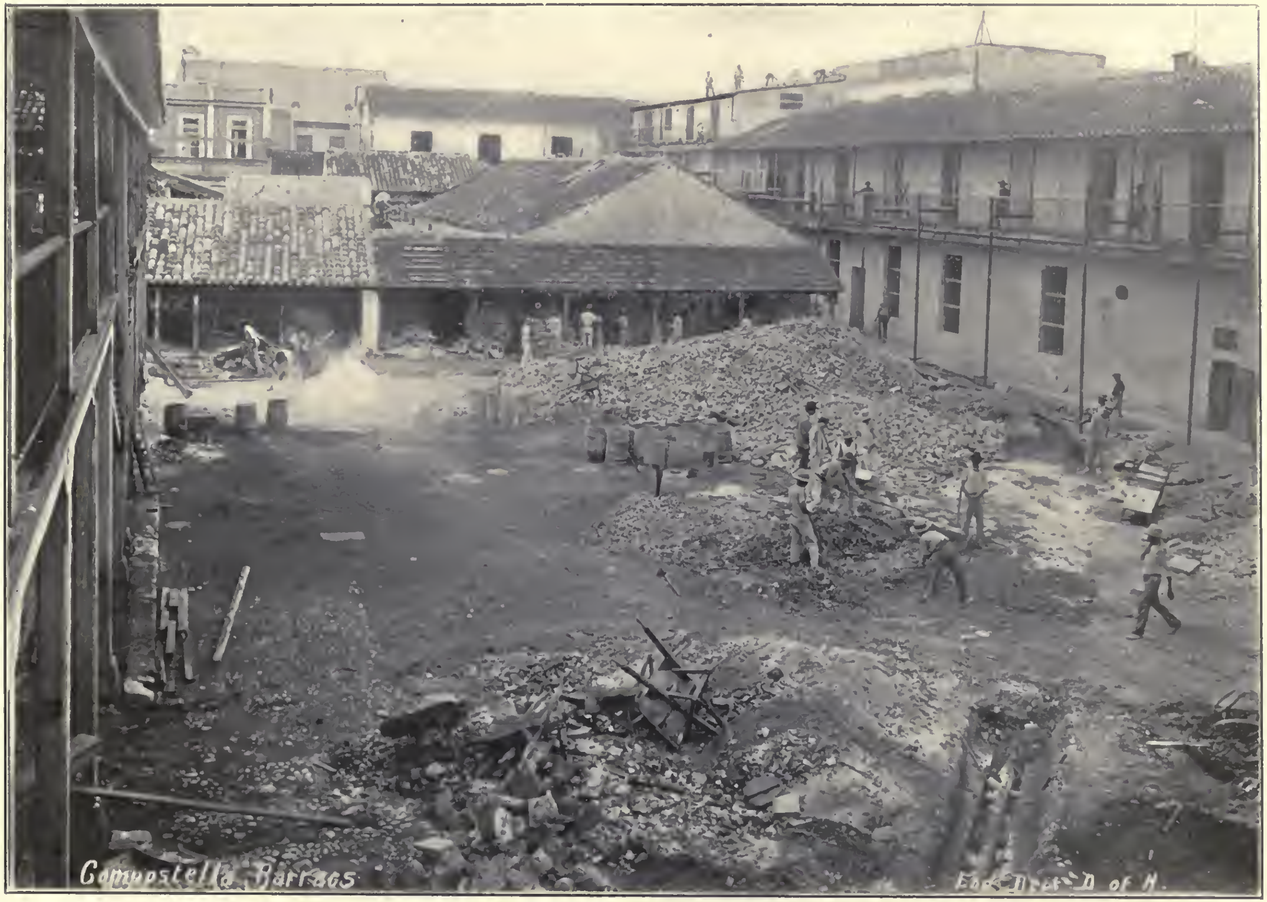
The streets were washed as thoroughly as the houses, 33,000 gallons of electrozone often being used in one day for this purpose. This electrozone proved very effective, and is a comparatively new idea in street cleaning. It had been used in New York previously with partial success. Major Black heard of it and succeeded in introducing it into Cuba. Electrozone costs very little, as it is made by the electrolysis of sea water by the cheap process discovered by an American several years ago. Two strengths were used: one, of a very strong quality, for a disinfectant, and the other, of a weak quality, for a deodorizer.

The magnificent sea wall and promenade shown in picture No. 9 was built under Major Black's personal direction. The promenade is placed at the end of the Prado, the wide avenue which is a favorite drive of the inhabitants. Formerly the beach was the dumping ground of everything offensive to the nose and eye. The stones in front of the wall are designed to break the force of the surf. When the plan of building this wall was announced a great outcry arose about American extravagance, and the government was charged with scheming to squander a quarter of a million dollars of the people's money.

As a matter of fact, the wall cost about $10,000. Its cheapness has been a wonder to the citizens of the town,



No. 9. The Sea Wall Built at the End of the Prado Promenade by Major Black



No. 10. Cleaning the Barracks

who are accustomed to generations of officials careless of the course of public funds. It is now planned to continue the wall some distance further. Thousands of people come here for their daily promenade to watch the breaking of the great waves and enjoy the fresh breezes from the sea.

It should be remembered that every dollar spent for the improvements of the capital and elsewhere in the island of Cuba has come from the pockets of the Cubans, and not one cent from the United States.

The Cubans have not liked the process which has made them cleaner and healthier. If they could have voted on it, probably they would have vetoed to a man the house and street cleaning proposition. What was good enough for their fathers and grandfathers was quite good enough for them. But now that the parks have been made enjoyable and sea promenades built where they can loaf at ease and in safety, they begin to take pride in the improvements to their capital.

The reputation of the city of Habana is rapidly changing for the better. The beautiful surroundings which Nature has given it and the mildness of its climate in winter make the city a Paradise to northerners during the harsh season of the year. There are many who believe that Palm Beach and the winter resorts of Florida are many times eclipsed by the charms of the Cuban capital, and that in the near future it will rightly become the most popular of American winter resorts.

CUBAN RAILWAYS

BY ALBERT G. ROBINSON

CUBA was no laggard in the adoption of steam railways as a means of transportation. I have not at hand the date of the opening of the first Cuban railway, a 43-mile line from Habana to Guines, but it came within a few years of the opening of the first American line. Following a concession granted by Governor General Tacon in 1837, the Puerto Principe and Nuevitas line was opened in 1851. The Matanzas-Sabanilla road was opened in 1854. Others followed until, at the time of the American occupation, on January 1, 1899, Cuba could boast of 124 railroads, with a total length of 2,100 miles, representing a valuation of $70,000,000.

The Puerto Principe-Nuevitas system deserves a passing note for its peculiarity. Its capital is $1,000,000, represented by eight shares, though no printed stock certificates have ever been issued. It is practically a private corporation. Three stockholders are elected annually to serve as a director, a treasurer, and a secretary. They serve without pay and are not eligible for reelection. The road has neither mortgage nor outstanding indebtedness. Its expenses are paid from its receipts. For the fiscal year ending June 30, 1900, its earnings were $292,442.42. Its operating expenses were $191,120.33, leaving $124,312.88, which was paid as dividends to its eight stockholders.

The number of Cuban railways (124) seems out of proportion to the mileage until it is understood that only 17 are public lines. The remaining 107 are private roads for the transportation of sugar-cane in the vicinity of the large *centrales*, or grinding mills. The 17 public lines cover 1,135 miles. Of this all except 162 miles are in the western half of the island. The system of the eastern half is represented by four short lines running to interior points from the ports of Santiago, Guantanamo, Gibara, and Nuevitas, and by a Spanish military road across the island, along the line of the Jucaro-Moron trocha. This was constructed with the expectation that it would enable the Spanish army to limit insurgent activities to the region of their inception—the provinces of Santiago and Puerto Principe.

Much the larger part of the Cuban railway system is now in the hands of English companies. English capital was represented prior to the insurrection, and its holdings have been largely increased during recent years, notably about the time of the American occupation. Purchases were made at prices which American investors did not care to touch, in view of the condition of the properties and the uncertainty of those prompt returns which are a much more important item in the mind of the American investor than they are in the mind of his English competitor in the world of finance. The principal systems, five in number, represent about nine-elevenths of all the public lines. These are under English control, though some American money is represented among the stockholders.

The private roads are practically feeders to the public lines, though some run to coast ports. Thus the United Fruit Company operates 29 miles of railway, with 7 locomotives and 300 cars. This runs from the company's plantations to the shipping port of Banes. The Terry estate operates some 65 miles of road, with 16 locomotives and 700 cars. Of the private lines which connect with the public lines, some use their own equipment and some use the equipment of the lines with which they connect. The 107 roads represent an investment of nearly $12,000,000.

At the close of the war many of these lines, both public and private, were in exceedingly bad condition as a result of the destructive methods employed by the contending parties. Equipment had been wrecked, stations burned, bridges and culverts blown up, and road-bed neglected. Travel over them meant so many hours of misery at exorbitant rates of fare. There has been a notable improvement in physical conditions, but the rates are still excessive. These average about 7 cents per mile for first-class passengers and about 5 cents per mile for second-class. On some runs I have paid as high as 12 cents per mile. Freight rates are also exorbitant, and a serious detriment to the welfare and the development of the country. Some effort is now being made to effect a modification of rates by military order, though the legality of the step is somewhat doubtful.

But the railway feature of the greatest importance in the island is the line which is now in process of construction by Sir William Van Horne and his associates of the Cuba Central Railway. This will connect at Santa Clara with the lines now running from Havana to Cienfuegos. It will extend eastward for a distance of some 350 miles, *via* Ciego de Avila, Puerto Principe, and Las Tunas, to the Bay of Nipe, on the northeastern coast, which will become a prominent port of shipment. Nipe is perhaps the best harbor on the whole Cuban coast line. This company has also purchased the short line now running northward from Santiago. This will be extended to the main line from Santa Clara to Nipe. With these lines completed, there will be railway connection from Santiago to Pinar del Rio, a distance of some 600 miles.

The benefits of this system are not to be estimated. It will open a vast area of fertile land for cultivation and settlement. The railway project is, in fact, little more than an incident in a great scheme of insular development. The road will tap, by means of radiating lines, the country to north and south of its course. It will open for profitable cultivation an area of approximately 10,000,000 acres, or about one-third of the total acreage of the island, hitherto practically undeveloped. Along its route there will be sugar estates and cattle ranges. There will also be groves and orchards. Small farmers will grow vegetables and small fruits for our winter market.

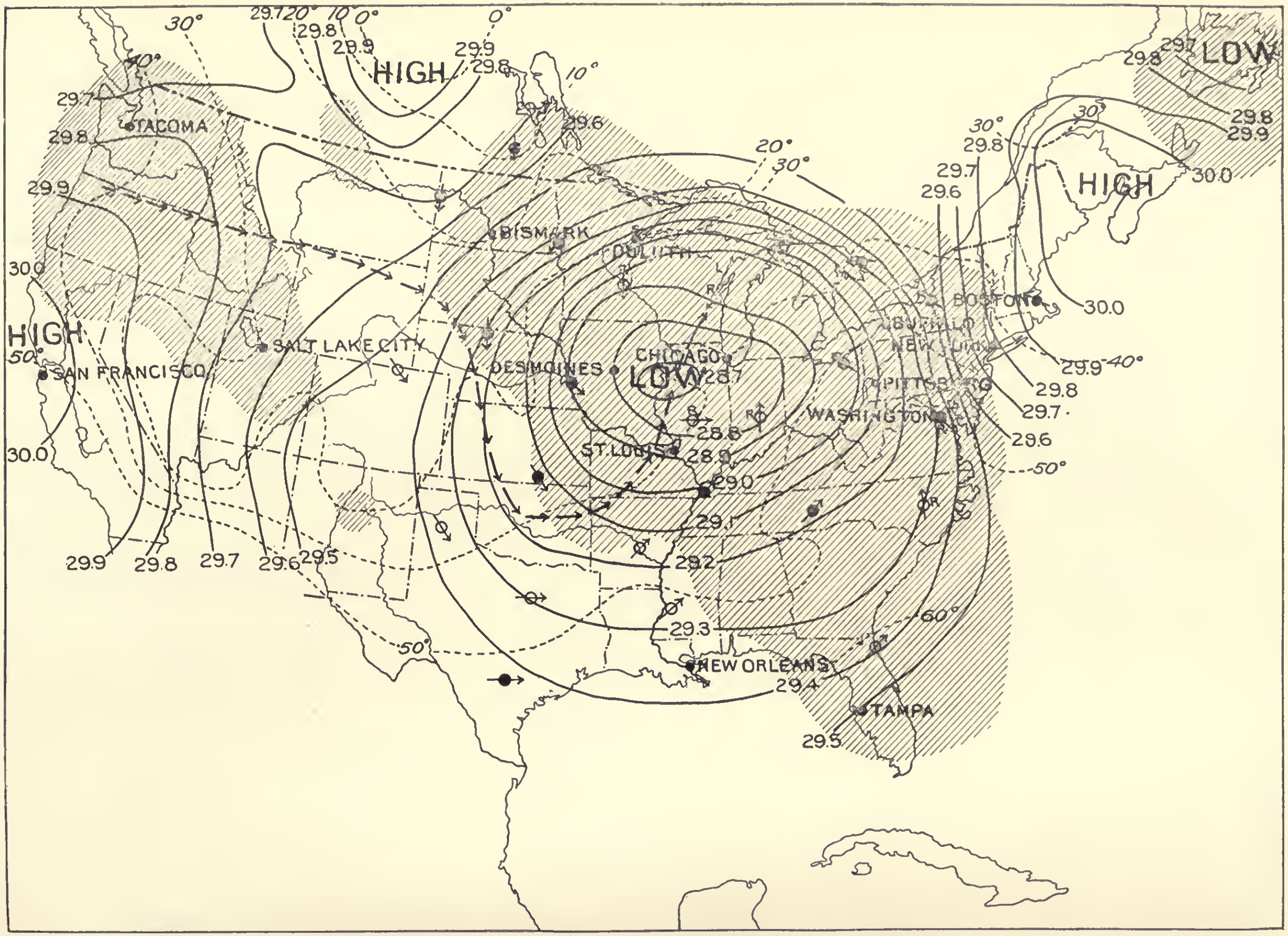
Nipe Bay is but 60 hours distant from New York by such steamers as will one day run between the ports. Trains from inland points, connecting with these steamers, will bring us, for winter consumption, fresh vegetables, strawberries, and other small fruits grown under natural conditions and laid down in our eastern cities during the season when such a supply is most acceptable.

Cuba has yet to pass through a period of political stress and trial, and probably through a period of financial liquidation. Her political problems will be solved, probably at no distant day, by her absorption into the American Union. In the solution of her financial and industrial problems, the extension and development of her railway system will be an important, if not the determining, factor. Upon the ashes of her insurrection, and out of the throes of political reconstruction, there will come a new Cuba, a land of law and order, of peace and plenty. Cuba will become in fact as well as in name The Pearl of the Antilles.

THE STORM OF FEBRUARY 25-28, 1902

THE tempestuous weather of February, 1902, culminated in one of the most remarkable storms in the history of the Weather Service. The storm came direct from the Pacific, striking the Washington, Oregon, and California coasts almost simultaneously, early Tuesday morning, February 25, 1902. In the next 24 hours its front had pushed well across the Rocky Mountains, leaving a trail of rain from San Diego and the desert region of the Southwest to the northern boundary. Twelve hours later—that is, at 8 p. m., 75th meridian time—Wednesday, February 26, it had debouched over the dry plains east of the Rocky Mountains as a violent wind storm without precipitation. The winds at the storm center on Wednesday were relatively light—10 to 12 miles per hour—but around the periphery of the storm, in the southwest quadrant, especially, winds of 60 to 70 miles per hour prevailed.

The movement of the storm after leaving Oklahoma, where it was central Wednesday evening, was quite slow. It reached southwestern Missouri by 8 o'clock Thursday morning, and eastern Iowa by Friday morning at the same hour. Thence it moved slowly northeastward into the upper lake region, where it was last observed Saturday evening, March 1. The effect of the slow movement of the storm during and subsequently to the time of recurving in Oklahoma and Arkansas was to set the air east of the Rocky Mountains in motion around the storm center in a direction contrary to the movement of the hands of a watch. The weather map of Friday, February 28, 1902, illustrates the whirling of the air about a central point most beautifully, and at the same time presents the rather unique spectacle of the entire surface stratum of air, from the Rocky Mountains to the Atlantic, circling in a gigantic whirl about a single storm center. This circulation naturally produced striking contrasts in the weather experienced in widely separated parts of the



Weather Map, 8 a. m., February 28, 1902

Solid lines are isobars; broken lines are isotherms. The shaded portion of the map indicates the area over which precipitation has occurred during the 12 hours preceding 8 a. m., 25th meridian time, February 28, 1902. The arrows point in the direction in which the wind is blowing.

country: high temperatures, thunderstorms, and torrential rains in the southern and southeastern quadrants; rain, hail, and snow in the northwestern and western quadrants. The high temperatures and heavy rains, coming as they did after a brief period of rainy weather, conspired to swell the rivers and small streams of the south and east to dangerous and destructive stages. The flood in the Ohio River at Pittsburg was equal to that of 1884, but fell short of the great flood in 1832 by about two and a half feet. The monetary loss in damage to property, loss of wages and earnings in the city of Pittsburg alone will aggregate $1,250,000.

The remarkably low barometric pressure, not only in the center of the storm (28.68 inches, Friday morning, at Davenport, Iowa), but from ocean to ocean, was doubtless due to the rapid movement of several areas of low pressure across the United States, each low being followed in turn by a second low before pressure had risen appreciably in the rear of the first.

ALFRED J. HENRY.

AGRICULTURE IN ALASKA

THE article in this number by Prof. C. C. Georgeson, special agent, Department of Agriculture, upon the agricultural possibilities of Alaska, will doubtless be read with much interest. It is an excellent presentation of the subject from an extremely optimistic point of view.

It is easy to understand how an agriculturist, meeting with success in a land which has always been considered a frozen, worthless waste, and who, through the employment of careful, scientific methods, is rewarded by the growth and maturity of cereals and vegetables, could become enthusiastic over the productivity of Alaskan soil and the possible results awaiting its cultivation. Professor Georgeson is sincere, but his error (for most scientists familiar with Alaska believe him to be in error) lies in the fact that his enthusiastic statements are in danger of leading the reader to believe that agriculture on a commercial scale is possible in Alaska.

While it is admittedly true that hardy grains and vegetables have been brought to maturity at various points on the coast and in the interior, the climate must always prevent this northwestern territory from becoming a successful farming region. To be successful, farm products must be grown at a less expense than they can be raised in California, Oregon, or Washington, plus the cost of transportation. We do not think that Professor Georgeson would maintain that farmers upon the Alaskan coast could compete in their home markets with the Pacific states. In the interior of Alaska, where climatic conditions are more favorable than upon the coast, the summers being hotter and less moist, and where home products would be protected by higher transportation rates, it may be possible to maintain successful competition, although that is a matter yet to be demonstrated.

HENRY GANNETT.

GEOGRAPHIC NOTES

DR. BELL'S SURVEY IN BAFFINLAND

"BAFFINLAND is a large island on the west side of Baffin Bay, or opposite to Greenland. It stretches from Hudson Strait northwestwards through twelve degrees of latitude, or from 61° 40′ to 74° north. It is the third largest island in the world, being only exceeded by Greenland and Australia. Its total length is 1,005 English statute miles, and its breadth varies from 200 to 500 miles, the average being 305. The area is therefore about 300,000 square miles, or about ten times that of Scotland or Ireland. It forms, however, only about one-tenth of the superficies of the Dominion of Canada. Notwithstanding its immense extent, it appears to be of no great value, since it is composed, as far as we know, of barren rocks, partly covered with ice." So writes Dr. Robert Bell, Director of the Geological Survey of Canada, in a summary account of work printed in the *Geographical Journal* for July, 1901. The survey occupied the summer of 1897, from July 20, when the *Diana* put off the survey party in a little yacht (with a year's supplies against emergency) on the stormy and tide-swept coast, until September 12, when they were taken up by the same vessel. The coast-line was found exceedingly complex and bordered by literal thousands of islands—*i. e.*, the country from North Bay nearly to Fox Channel is a deeply incised plateau, inclining westward, and half submerged beneath the waters of Hudson Strait. The interior is mainly bleak and barren, with scant herbage in places, a meager fauna, and an Eskimo population estimated at 670 for the whole of Baffinland. Much of the land is a permanent ice-field like interior Greenland, and glaciers of great extent feed bergs to the adjacent seas; while in the comparatively ice-free interior there are several great lakes, hundreds of lakelets, and many rivers. Dr. Bell discovered Lake Amadjuak, about 120 miles long and 40 miles broad, at an altitude of about 290 feet, and, through Eskimo accounts, located the still larger Lake Nettelling at a somewhat lower level; while the coast surveys located a number of safe harbors. The local nomenclature applied by Dr. Bell is a monument to contemporary geography and geology; the National Geographic Society Board is perpetuated by McGee Lake, Gannett Lake, Gilbert Lake, Merriam Lake, Hyde Lake, and Greely Lake; Powell Lake, Winchell Lake, Walcott Lake, Stevenson Lake, Franz Boas Lake, Orton Lake, Emerson Lake, Bailey Island, Chamberlin Island, and Cape Salisbury commemorate well-known American geologists and geographers, and British geographers, geologists, and other personages are equally remembered, while McKinley Island and Hobart Island pay compliment to the neighboring nation; yet the old nomenclature, from Frobisher down, is retained for larger features, and the local Eskimo names are applied wherever known.

W J McGee.

NOTABLE WORK ON ALASKA

MR. MARCUS BAKER is the author of an official geographic dictionary of Alaska just published by the U. S. Geological Survey. It consists of 450 pages packed with information, descriptive, geographic, and historical, on the Alaskan territory. The volume is a summary of almost every fact about Alaska which the American wants to know but does not know where to find. Mr. Baker has been working a number of years on this work. Ten years ago the Board of Geographic Names decided to prepare a geographic dictionary of Alaska, and appointed a committee consisting of Mr. Herbert G. Ogden and Mr. Marcus Baker to conduct the work. Later the editorship devolved on Mr. Baker.

The introduction to the work explains the origin of Alaskan names. Naturally many of the names were bestowed by the Russians prior to the purchase of Alaska by the United States. A few of the names were given by Spanish explorers along the southern coast during the last quarter of the 18th century. Cook, Vancouver, Captain Beechey, and other Englishmen also named many capes and headlands. Americans did not begin bestowing names in Alaska until 1848, but since that time they have bestowed many hundreds. But, as Mr. Baker says, the most important are the names given by the natives, Eskimo and Indian.

Perhaps the most valuable feature of this very notable work is a list of the different exploring expeditions of Alaska, with a brief summary of the results of each expedition and references to the separate published reports. An idea of the patient and exact scholarship required to bring the work to such a successful termination may be obtained from the fact that over 7,000 names are included in the dictionary. The volume may be obtained from the Geological Survey for the nominal sum of 30 cents.

MOUNT ATHOS

IT is a firm belief of the Eastern monks that God will not allow a monastery to be burned. When the Russian monastery of Saint Pantelemon at Mount Athos was burned a few years ago, the Greeks, who constitute the great majority of the 6,000 monks on the peninsula, maintained that their Russian brethren had brought the calamity on themselves because they had fire-engines and extinguishers and did not trust wholly in God. Now the neighboring Greek monastery of Saint Paul, which had no fire-engines, has recently, together with all its treasures, been utterly destroyed by fire.

This was one of the more modern and less populous of the twenty monasteries which dot Mount Athos. It was erected in the 14th century and had less than 60 inmates. But its reliquary possessed many Byzantine objects of great interest, the more remarkable being a Byzantine model of Herod's temple and a silver cross, 3 feet 1 inch in length, covered with jewels and exquisite miniature portraits of the saints in enamel. The library consisted of about 120 manuscripts, the majority in Slavic and a few in Greek.

Most of the monks came from the Ionian Islands, and though those islands passed from the control of Great Britain in 1862, were commonly called "Englishmen" by their coreligionists. This is said to have been the only monastery at Mount Athos which has ever been visited by a woman. The wife of a British embassador landed from her yacht one day on its tiny pier and insisted on entering the church. In consequence the monks, relieving each other by relays, for 40 days and nights maintained a continuous service of prayer to purify the church from this contamination.

BUREAU OF FORESTRY

THE important work the Bureau of Forestry is doing in promoting interest in the welfare of the forests of the country and the large results obtained in 1901 are described by the Forester, Mr. Gifford Pinchot, in his last annual report. The Bureau is now giving practical assistance and advice in the management of 50,000,000 acres of national, state, and private forest lands, an area larger than the state of Nebraska. An efficient organization of trained men has been formed, whose *esprit de corps* and enthusiasm is most marked.

During the year 1901 38 private owners applied to the Bureau for assistance in the care of their forest lands; these included lumber companies in Arkansas, Missouri, New York, and Maine, and Hon. William C. Whitney. In each case a working plan was made for the owner. An examination of the Black Hills Forest Reserve, where practical forestry is urgently needed, was made, and a working plan for the reserve is nearly ready. The Prescott, Big Horn, and Priest River forest reserves were also examined for the same purpose.

Mr. Pinchot announces that an extensive investigation of the forest conditions of Nebraska has been carried far enough to show that it is feasible to replant large areas hitherto believed to be permanently treeless. The forests of Texas have been carefully studied and will form the subject of an early special report. Many owners of unprofitable cleared or treeless lands have received assistance from the Bureau, and by replanting have made these lands of value.

The Bureau of Foresty is studying the native trees of the United States and Philippines that yield commercial tanbarks, resins, and gums. As many as 50 species are being tested in conjunction with the Bureau of Chemistry. Another investigation of the greatest importance aims to find the causes and prevention of decay of railroad ties and timber, and to discover what trees will produce railroad ties in the shortest time.

LOSS OF LIFE BY LIGHTNING

FROM 700 to 800 persons are killed annually in the United States from lightning strokes, is the estimate given by Prof. A. J. Henry in a bulletin on the subject recently published by the U. S. Weather Bureau. For some years the Weather Bureau has been seeking to ascertain the loss of life from this cause, and in 1900 received actual records of 713 fatal cases of lightning stroke. This number was obtained from the reports of the many officials of the Bureau throughout the country and from lightning cases cited in the newspapers, especially in the journals of the rural districts. During the two years of 1899–1900 as many as 30,000 clippings were received by the Bureau from one clipping agency, which shows that the lightning strokes were carefully watched. Of course, most of the clippings were duplicates, sometimes as many as 50 notices of the same case being received.

The loss of life from lightning is greatest in the Ohio Valley and the Middle Atlantic States, if we consider both unit area and density of population. If density of population only be considered, it is greatest in the Upper Missouri Valley and in the Middle Rocky Mountain region. Of the 713 fatal cases reported in 1900, 291 were killed in the open, 158 in houses, 57 under trees, and 56 in barns, and the circumstances attending the death of the remaining 151 are not known. During the same year nearly one thousand—973 persons—were more or less injured by lightning. The Weather Bureau has discontinued collecting statistics of loss of life by lightning. The experience of the past years has convinced it that the practical results of the enquiry do not justify the expenditure of time and money.

U. S. GEOLOGICAL SURVEY

RECENT publications by the U. S. Geological Survey include:

"Geology and Water Resources of Nez Perce County, Idaho." By Israel C. Russell. Professor Russell describes at considerable length the Columbia River Lava formation of Washington, Oregon, and western Idaho. This area produces annually from 50,000,000 to 60,000,000 bushels of wheat and large quantities of other grain. The fine, dark, rich soil, almost unrivaled in fertility, has resulted from the disintegration and decay of volcanic rocks which, in a sea of lava, inundated the region in mid-Tertiary times. Further notice of this notable work will appear later in this Magazine.

"The Lead and Zinc Deposits of the Ozark Region," by H. F. Bain, with an introduction by C. R. Van Hise, and chapters on the physiography and geology, by George I. Adams. The Ozark region is an elliptical area, about 300 miles long by 200 miles wide, embracing the southern half of Missouri, the northern third of Kansas, and small adjacent portions of Illinois, Kansas, and Indian Territory. The region is rich in minerals of economic importance.

"The Asphalt and Bituminous Rock Deposits of the United States." By George H. Eldridge.

"The Gold Belt of the Blue Mountains of Oregon." By Waldemar Lindgren. Three-fourths of the gold output of the state is from the Blue Mountains. Within the last few years this region has resumed the prominent position among the gold-bearing areas which it held about forty years ago.

"Oil and Gas Fields of the Western Interior and Northern Texas Coal Measures," by George I. Adams.

"The Geology and Mineral Resources of the Copper River District, Alaska," by F. C. Schrader and A. C. Spencer.

"Geology and Water Resources of Yakima County, Washington," by G. O. Smith. These publications may be obtained for a nominal sum.

TREASURY BUREAU OF STATISTICS

EVERY bulletin and publication issued by this department contains information, usually unobtainable elsewhere, on some living topic of the day. Recent monographs include:

"The Danish West Indies," a summary of facts about the three little islands whose annexation to the United States is now imminent.

"Commercial Japan in 1900," a new edition of a monograph first published in December, 1901. The work includes a scholarly treatise on "The development of commerce in Japan, and its effect on civilization in that country," by Chohei Shirasu, A. M. (a native of Japan). It was by this treatise that Mr. Shirasu gained the degree of master of arts from Columbia.

"Great Canals of the World," condensed information and statistics in regard to all the great artificial waterways of the world—the Suez, Kaiser Wilhelm, Manchester, Canadian, St. Marys Falls, New York State, canals in India, Holland, Belgium, etc.

"Statistical Abstract of the United States." Solid columns of figures are not usually interesting, but the tables in this report are really picturesque. They are arranged in parallels in such a manner as to give a graphic picture of the gigantic leaps of the United States in every direction during the past century. This is a work that should be studied by every geographer, historian, teacher, or man of affairs in the United States.

ATLAS OF THE PHILIPPINES

SOME months ago the first Philippine Commission published, under the auspices of the U. S. Coast and Geodetic Survey, an atlas of the Philippines comprising some 30 colored maps of the different islands of the archipelago. The edition was, however, so small that very few were fortunate enough to secure a copy. General A. W. Greely has recently published a large second edition of this atlas under the auspices of the Signal Office, and responsible persons may obtain a copy by addressing the War Department. For many years the Jesuit Fathers of Manila had been preparing a series of maps of the more important islands. They were much handicapped by an absolute want of accurate surveys, but they secured all available data and such information as they could get from other religious orders, the old residents and explorers. The first Philippine Commission decided to publish the series for want of anything better, and this was done under the editorship of Father Jose Algué, Director of the Manila Observatory. The maps necessarily are not so recent as the War Department map, which was published as a supplement to the January number of this Magazine.

Argentina-Chile Boundary.—The recent acute difficulties between Argentina and Chile have been temporarily settled. It will be remembered that the recent strained relations were caused by Chile's sending police into certain sections of the disputed territory, and also building roads at alleged strategic points in the territory. In the protocol signed by the two republics Chile declares definitely that the roads were opened merely in order to explore the country and to help the experts who were studying the boundary line, and that in no sense did the act of building the roads mean an occupation of the territory. The two republics furthermore agree to police jointly such sections as may need police regulations. About a year ago Argentine submitted to the British arbitration committee four quarto volumes of evidence and a large portfolio of maps in support of its claims. Chile has at last also submitted its final documents, and it is hoped a permanent decision of the boundary dispute will soon be reached.

Dr. Eugene Murray-Aaron, editor of Cram's Atlas, has recently compiled from latest surveys a bird's-eye view of the Maritime Canal and the Isthmus of Panama. It is an excellent piece of work and is published by George F. Cram (Chicago).

GEOGRAPHIC LITERATURE

Wandering in Three Continents. By the late Captain Sir Richard F. Burton. Edited by W. H. Wilkins, M. A. With illustrations. New York: Dodd, Mead & Co., 1901. $3.5c *net.*

The volume gives a fascinating account of the bold wanderings of this great traveler. Burton was the first European to enter Mecca and Medina disguised as one of the people, 1853; he penetrated Abyssinia in the days when it was as forbidden ground as Mecca; with Speke he discovered that vast inland African lake, Tanganyika, rumors of which had for centuries been whispered on the seacoast; he went on a dangerous mission as British envoy to the King of Dahomey, and was a guest of his wild court and protected by the army of Amazons; later he explored the interior of Brazil, and in 1870, while consul at Damascus, made an eventful trip to Palmyra. "Wandering in Three Continents" consists of eleven popular essays or lectures on these journeys. Burton wrote many heavy works of travel, but none of a popular form, so that this posthumous volume of popular essays is specially welcome. Five of the essays were read before the Emperor and Empress of Brazil while he was consul at Santos, and the others before distinguished gatherings in England and Scotland.

Cram's Atlas of the World, Ancient and Modern. New Census edition. Edited by George F. Cram, Dr. Eugene Murray-Aaron, I. C. Clare, and others. New York and Chicago: George F. Cram, 1901. $10.

For the general uses of the home or school this atlas is unequaled. The design of the editors has been to publish a volume that would answer the needs of the general reader and student, and to produce it at a moderate price. In addition to the many modern maps and admirable historical charts, the editors have included a series of statistical diagrams showing the world's distribution of population, of wheat, minerals, etc. There are also a number of astronomical maps and much interesting descriptive matter about the different countries, the progress of knowledge during the nineteenth century, etc. In the maps and matter relating to America the atlas excels. The editors have incorporated the latest data from the geographic and scientific bureaus of the United States Government. For instance, in the spelling of geographic names the rulings of the U. S. Board on Geographic Names have been followed. This latest edition of Cram's well-known atlas has been entirely rewritten, hundreds of new photographs have been added, all the maps reëngraved, and many new maps added. Dr. Murray-Aaron and his large staff of workers have made a splendid work. The one apparent defect is an omission of many of the routes of the great explorers in history. A series of maps outlining the main routes of discovery on land and ocean would add to the value of the atlas.

NATIONAL GEOGRAPHIC SOCIETY

PROCEEDINGS

MEETING OF THE SOCIETY :

February 7, 1902.—President Graham Bell in the chair.

Maj. William M. Black gave an address on "Some American Work in Cuba."

February 21.—Meeting postponed to March 7.

LECTURES :

February 14.—President Graham Bell in the chair.

Hon James Wilson, Secretary of Agriculture, and Prof. Joseph A. Holmes, State Geologist of North Carolina, gave addresses on "The Proposed Appalachian Forest Reserve." Both addresses will be published later.

February 28.—President Graham Bell in the chair.

Hon. E. F. McSweeney, Assistant Commissioner of Immigration, gave an illustrated address on "Fifty Years of Immigration," which will be published later.

ANNOUNCEMENTS

MEETINGS OF THE SOCIETY :

March 7.—"Notes on the Geography of Alaska." Alfred H. Brooks, U. S. Geological Survey.

"Petroleum Resources of the United States." Dr. C. Willard Hayes, U. S. Geological Survey.

March 21.—"Mt. Wrangell." Robert Dunn, of New York.

LECTURES :

March 12.*—"Problems of the Pacific—Japan." Prof. E. F. Fenollosa, University of Tokio, Japan.

March 14.—"American Progress in Cuba." Maj. William M. Black.

March 19.*—"Australia and New Zealand." Henry Demarest Lloyd, author of "Newest England," etc.

March 26.*—"The Pacific Basin." G. K. Gilbert.

March 28.—Subject to be announced. Mr. George Kennan.

April 2.*—"Hawaii, Guam, and Australasia." Dr. Charles H. Townsend, U. S. Fish Commission.

The following standing committees have been appointed by President Graham Bell. The President is an *ex officio* member of all committees :

Committee on Publications.—Henry Gannett, A. W. Greely, W J McGee, C. Hart Merriam, David J. Hill, Marcus Baker, Willis L. Moore, O. P. Austin, Gilbert H Grosvenor, O. H. Tittmann, David T. Day, Miss E. R. Scidmore, Miss C. L. Garrison, Miss Ida M. Tarbell.

Committee on Communications (lectures).—W J McGee, A. J. Henry, Gifford Pinchot, Gilbert H. Grosvenor, Herbert Putnam.

Committee on Admissions.—Marcus Baker, John Joy Edson, H. F. Blount.

Committee on Research.—G. K. Gilbert, C. Hart Merriam, A. W. Greely, G. W. Melville.

Committee on Finance.—Charles J. Bell, Henry Gannett, John Joy Edson.

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*To be held in Columbia Theater, Twelfth and F streets, Washington, at 4.20 p. m.

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THE NATIONAL GEOGRAPHIC MAGAZINE

RECENT FRENCH EXPLORATIONS IN AFRICA

BY DR. CHARLES RABOT, EDITOR OF "LA GÉOGRAPHIE"

THE closing of the nineteenth century and the beginning of the twentieth are noted for important explorations in Africa by the French Government. In order to establish beyond dispute her sovereignty over the *hinterland* of her colonies, and to connect the scattered members of her colonial empire in Africa, France has been directing a number of military and civil expeditions whose results have greatly enriched our geographical knowledge of the northern half of the continent.

The regions in which the French have been specially active belong to three different zones: in the north, the Sahara; then passing southward, the Sudan or the higher basin of the Niger; and, thirdly, the tropical forest stretching from Guinea across the middle and lower basins of the Niger to the Kongo and beyond, the forest in the interior giving way to a land of dense brush.

The most famous of the French expeditions in Africa is that of Colonel Marchand. Its object was political—to prevent England from realizing her long-cherished plan of an African Empire stretching from Cape to Cairo. The Marchand expedition started from the Upper Ubangi for the east, while another expedition, commanded by Marquis de Bonchamp, then M. Michel, advancing from Abyssinia toward the west, was to meet him at the Nile. If this scheme failed politically, from a geographic point of view it was a magnificent success. The Marchand expedition, which, besides its chief, included seven officers, has obtained a very careful map of the entire region, in large part previously unknown, which stretches across Africa between the parallels of 5° and 10° north latitude. Lieutenant Commander Dyé, the astronomer of the party, determined the position of 75 points between Bangui, in the Kongo basin, and Jibuti, on the Red Sea. A large map on the scale of 1 : 3,000,000 will soon be published by the officers of the expedition, showing the country explored by them, but no account of this expedition has yet been published by any member of the party.

No less worthy of admiration than their cartographic achievements are the heroic efforts of Marchand and his party in dragging to the very heart of Africa the boats and barges which they would need on the Nile. The Kongo and its tributaries and sub-tributaries, the Ubangi and the Mbomo, are cut by frequent rapids. To pass these barriers the boats were carried through the forests, sometimes dismantled, sometimes dragged just as they were. Troops of negroes, 1,800 in all, would take hold of the boats and push them along on tree trunks stretched across the yielding earth. Thus the party advanced to Brazzaville, the chief French post on the Kongo, situated at the head of navigation of the Ubangi, sometimes traveling in their boats on the river, but very often dragging and pushing them along instead. The distance they traveled thus was 2,187 miles. Between the basins of the Kongo-Ubangi, and the Nile, the water-divide consists of a slightly undulating plateau, in which the streams follow an uncertain course, so gentle is the slope of the divide. In order to carry the boats across this region, the soldiers of the expedition and the negroes opened a road one hundred miles long, over which they shoved the boats and barges. The party reached the basin of the Bahr-el-Ghazal, a tributary of the Nile, in 1897; the low water prevented them from continuing their march; it was not till 1898 that they gained Fashoda on the Nile. From Fashoda, Colonel Marchand continued his march eastward and through Lobat and the lofty Ethiopian plateau, reached Jibuti, on the Red sea, after a complete crossing of the continent.

A Scout in the Desert

Photo by Flamand

In the country of Bahr-el-Ghazal, Commander Roulet, who was sent to join Marchand, gathered much interesting geographic information. According to this officer, Souet, Iba, and Ruwa, tributaries of the Bahr-el-Ghazal, are dry from December to May. From June to November they rise to a height of 15 to 24 feet, submerging the surrounding land and forming between the 8th and 9th parallels of north latitude an immense lake hundreds of miles in length.

The expedition that left Abyssinia before Marchand has brought back a survey of those upper tributaries whose union forms the Sobat. This survey was later completed by the Marchand party.

This expedition encountered terrible difficulties. While following the valley of the Baro toward the Nile in November, 1897, they fell into a country of morasses and tall grass, through which they toiled almost buried. One day ten hours of unceasing labor advanced them only three and one-half miles. The country was barren and gave no sustenance to the column. Worn with fever, with hunger, and fighting the morasses, deserted by the natives, the little French company were obliged to stop at the Sobat, at the junction of

M. Fernand Foureau

"If it can be done, I shall do it"

the Baro and Didessa. Finally, on June 22, 1898, two members of the party, MM. Potter and Faivre, who followed an army of King Menelik, reached the Nile, but were not able to remain there because they had insufficient supplies.

While these parties were working in the basin of the Nile, another no less important expedition, led by M. Fernand Foureau, left southern Algeria, intending to cross the Sahara from north to south in order to connect the French possessions of West Africa, the Niger, and the Tchad. All previous attempts to carry out this plan had been thwarted by the fierce Touaregs, those hardy bandits, who, fleeing on their swift camels, are the masters of the Sahara from Tripoli to Timbuktu and Tchad. The last French expedition organized to cross the desert, led by Colonel Flatters, had been massacred (1881). The Touaregs had not been chastised for their crime, and hence had become more audacious than ever.

The Foureau expedition was essentially scientific and peaceful in its aims, but the surest way of being peaceful is to be strong and able to compel respect by arms. The French Government therefore gave M. Foureau a military escort consisting of 285 Algerian soldiers and equipped with two Hotchkiss guns. The squadron included only 28 Europeans and was commanded by Captain Lamy. One thousand camels carried the provisions and supplies.

On the 23d of October, 1898, the expedition left Ouargla, marching directly southward for Air. The Sahara does not consist simply of stretches of sand; the zone of great dunes is succeeded by rocky plateaux and sharp, abrupt ravines. The crossing of this country presented fearful hardships. The first plateau, that of Tindesset (2,200 feet), required four days of effort and cost the lives of 40 camels. Afterward the climbing of the *massifs* of Tassili, Adrar, and Anahef caused the caravan much suffering. The divide between the waters of the Mediterranean and Atlantic passes along these ridges; at the point where Foureau crossed, it reaches a height of 4,533 feet; further to the west the mountains rise to 5,400 feet, and in Ahaggar the summits are as high as 6,000 feet, and in winter are sometimes covered with snow. The mountain relief is here much more prominent than has been supposed. Foureau's observations have shown that the water parting is 188 miles farther to the south than is given on the maps. In the country of Tassili the caravan experienced quite low temperatures, 13.8° Fahrenheit, January 3, 1899. Beyond the plateaux stretches a barren sea of rocks; no water, no trees, rare

1. Crossing the Sahara.

2. The Great Dunes

3. Resting in the Plateau of Tindesset

4. "The Great Dunes Are Succeeded by Rocky Plateaux"

Photos by Foureau

and thin patches of herbs for the camels. Under the relentless sun 140 camels perished in seven days. One hundred and more carcasses, seen in 48 hours of march, told Foureau, however, that the native caravans suffered no less in this fearful desert. February 24, 1899, the expedition reached Iferouane, the most northerly town of Air, having lost 400 camels, and with all that remained worn to the bone.

Foureau stayed three months at Iferouane to explore the oasis and to purchase new camels, so that he might continue his march. But the Touaregs stripped the country round about and furthermore bulldozed the natives from selling them anything. After a while they did not hesitate to attack the French caravan itself. They could not stay forever at Iferouane, so on May 26 one party of the expedition began the journey southward, carrying such baggage as they could on the camels that were still strong and leaving the remainder to the care of an escort. It was during their stay at Iferouane that they experienced the severest temperatures of the journey, 115.7° Fahrenheit, on May 19.

When they reached Aquellal, situated 31 miles south of Iferouane at the foot of a chain of mountains, the camels were sent back to bring up the baggage that had been left behind; but they could not carry everything, and much that had cost them such pain and suffering to drag so far had to be burned. Meanwhile, the Touaregs were becoming bolder and bolder, and attacked the expedition again. On June 25 they again started south across dry mountains torn with ravines. The extremely difficult and painful passage cost them more camels and mules; all the horses that survived were turned into beasts of burden, and the officers marched afoot. Thus they gained Aouderas and Agades. The natives of the country everywhere adopted the same tactics—they concealed their supplies, and only when repeatedly threatened gave them out with great niggardness.

At last they had crossed the Sahara; Tagama, covered with low brush, now stretches before them; and later Damergou, strewn with wide fields of millet and clumps of gigantic jujub trees. Under the shade of one of these trees more than one hundred men could rest with ease. On November 2 Foureau reached Zinder, the most eastern of the French posts in the Sudan, after having crossed the Sahara from north to south, from Algiers to the French possessions in East Africa.

Watering the Horses at Lake Tchad

Photo by Foureau

From Zinder the expedition proceeded east toward Tchad in order to join two other expeditions—one from the west, commanded by Lieutenant Joalland, and the other from the south, commanded by M. Gentil. The union of these three parties was to establish the French control over the region of Tchad and to free the country of Rabah, a Mohammedan conqueror, who for several years had been ravaging this part of Africa. Foureau marched along the north and east shores of Lake Tchad. During this journey he determined the contour of the lake; he reports that the level of the lake varies as much as 40 feet during the year.

Early in April the three French parties met on the Shari, the principal tributary to Lake Tchad. The scientific mission of Foureau was now ended. His work includes a survey of 3,655 miles, from Ouargla, in Algiers, to Bangui, on the Ubangi, in French Kongo, of which 1,218 miles had never before been traversed by a European. This survey is based on 510 astronomical positions. Foureau has also determined the boundary between the sedimentary formations of Northern Sahara and the crystalline *massifs* of Central Sahara, and collected, in addition, many botanical, zoölogical, ethnographical, and archæological specimens. In the Sahara archæology is represented by many figures sculptured in rocks and by very curious ancient tombs.

The two other expeditions, under Gentil and Joalland, have obtained equally important scientific results. During the years 1899 and 1900 M. Gentil, commissioner of the Territories of Tchad, and his colleagues, made surveys of 4,600 miles included between the sources of the Ubangi, the Niger, and Tchad. The first of these regions is quite well populated, there being about 15 inhabitants to the square mile. M. Gentil in a boat steamed over a large part of Lake Tchad, and found that this great lake is navigable at all seasons of the year. The peoples living here are extremely interesting. At Zinder feudal institutions exist such as were in France at the beginning of the Middle Ages. The people are thus ten centuries behind the world.

After their union, the three French troops, about 700 men strong, on April 22, 1900, attacked the army of the Rabah. He had 7,000 men, of whom 2,000 were armed with rapid-fire guns; but the little French company put them to complete rout. The country of Tchad was thus acquired.

M. Gentil.

Besides these three principal expeditions of Marchand, Foureau, and Gentil, many other parties were exploring the different French Colonies of Africa. During December, 1899, to February, 1900, M. Flamand was exploring the oasis of Tibikelt, south of Algeria, where the phenomenon of eolian erosion is taking place. Flamand was attacked by the Arabs. The scientist immediately became a general, and with his 100 Arabs put his assailants to flight. By this victory France acquired the hitherto independent oases of Tidikelt, the possession of which will insure control of the tribes of the Sahara.

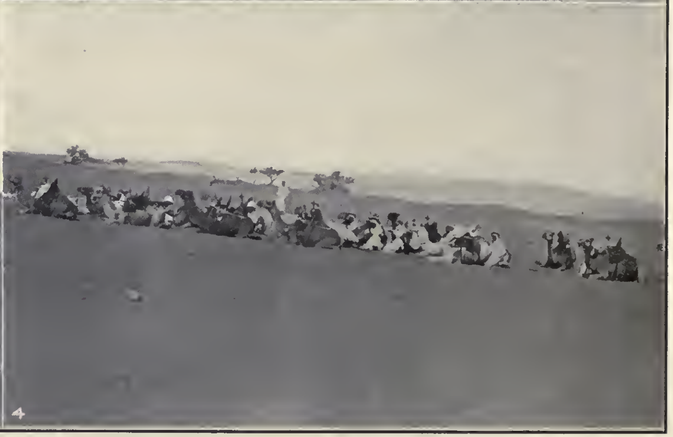
Less fortunate was the expedition of Blanchet in the region of Adrar, that part of the Sahara which is north of Senegal. The party was captured by the Moors, and remained in captivity for two months. When set free they were compelled to return.

In French West Africa three naturalists, Chevalier, Cligny, and Rambaud,

1. Senegal Musqueteers
3. Checking an Atttack

2. In Battle Line
4. On the Shari, near Busso

Photos by Gentil.



1. On the Road to Insala
2. Plateau of Insala
3. Marching Across the Desert—The Plateau of Tadmait
4. Ready for the Attack; the Men Crouch Behind the Camels

Photos by Flamand

Castle of Insala

Photo by Flamand

completed a scientific examination undertaken in order to discover the material resources of the colonies. This region consists of three botanical zones: First, *la zône sahélienne*, characterized by some species of the Sahara and by rare underbrush growing on bare and sandy soil; second, *la zône soudanienne*, consisting in the main of plateaux of laterite and covered from June to November by dense prairies or meadows of tall grass and many kinds of herbs; third, *la zône guinéenne*, covered in the lower regions by dense and impenetrable forests and, in the mountains by meadows or by underbrush, as in the zone of the Sudan. It is in this last zone, between 9° 30′ and 11° 30′ north latitude, that there grows in such abundance the *Landolphia heudelotii*, which furnishes all the caoutchouc exported from French West Africa. In 1900 the colony of French Guinea exported 1,464 tons of caoutchouc. This figure may be taken as the maximum production of the region.

In 1899 and 1900 the hinterland of the Ivory Coast and French Guinea was explored by M. Hostains and Captain d'Ollone. Ascending the basin of Cavally, they gained Beyla, situated in the upper basin of the Niger, and thence proceeded to Konakry, the principal town of French Guinea. They had marched from the sea to within a few miles of Beyla through the dense tropical forest, often without a guide and directed only by the compass. In the midst of this luxuriant vegetation, which hid everything from them, they were attacked by the natives. For six days they fought without resting, taking by storm 44 towns. Against the multitudes of negroes they had only an escort of 20 Senegalese soldiers.

All the people inhabiting this part of the tropical forest are cannibals, but they are nevertheless much more civilized than their neighbors; they weave cloth; their villages are quite substantial; their roads are well planned, and they cultivate many vegetables. They hunt men in the Sudan and capture all they can; their captives are then butchered and eaten. But they do not lack meat for they have cattle, goats, and sheep. When they kill a man, each, according to his rank, receives a special portion; one has a right to the shoulder, another to the thigh, a third to arm and liver. MM. Hostains and d'Ollone were the first Europeans who had penetrated to the country of these cannibals; the region will soon be occupied by military French posts, who will try to put an end to these horrible practices. To help the Hostains-d'Ollone party Captain Woelffel, with a company of 100 Senegal soldiers, started from northern Sudan to meet them, but the hostility of the natives prevented a junction of the two parties. Captain Woelffel was compelled to fight for every mile of advance, and soon had lost two-thirds of his men in killed and wounded.

The maps made by the two expeditions have greatly changed our former idea of the hydrographic basins of this part of Africa; these maps show the existence of high mountain ranges rising to 9,000 feet between the Sassandra, the Cavally, and the Niger.

From all the French colonies on the west coast of Africa many expeditions, often directed by the officers of the colonial army, have set out to explore the hinterland. Each has brought back a survey of a river or a district. Thus

A Street in Insala

Photo by Flamand

A Village in Madagascar

Photo by Guillaume Grandidier

Prince Roland Bonaparte

Twice President of the "Société de Géographie" of Paris, Honorary Member of the National Geographic Society, etc., etc.

little by little the blank spots on the map are disappearing. In French Kongo, and notably to the north of this colony, these expeditions have been particularly frequent in order to define the lands granted to the great colonizing companies. Among these explorers we may mention the journeys of M. Lesieur and Captain Jobit in the basin of the Ogooé. In the basin of the Kongo the course of many tributaries to this great African river have been determined.

The work of defining the boundaries between the different European colonies on the west coast of Africa has resulted in many detailed surveys; these boundaries have been defined between Gold Coast and the Sudan, between Nigeria and Dahomey, between French Kongo and the Spanish piece at Rio Mouni. Finally the reconnaissance for a railway route from Konakry to the Niger and the observations of Captain Lenfant as to the value of the Senegal and of the Niger for water routes to the interior of the continent have served the interests of geography.

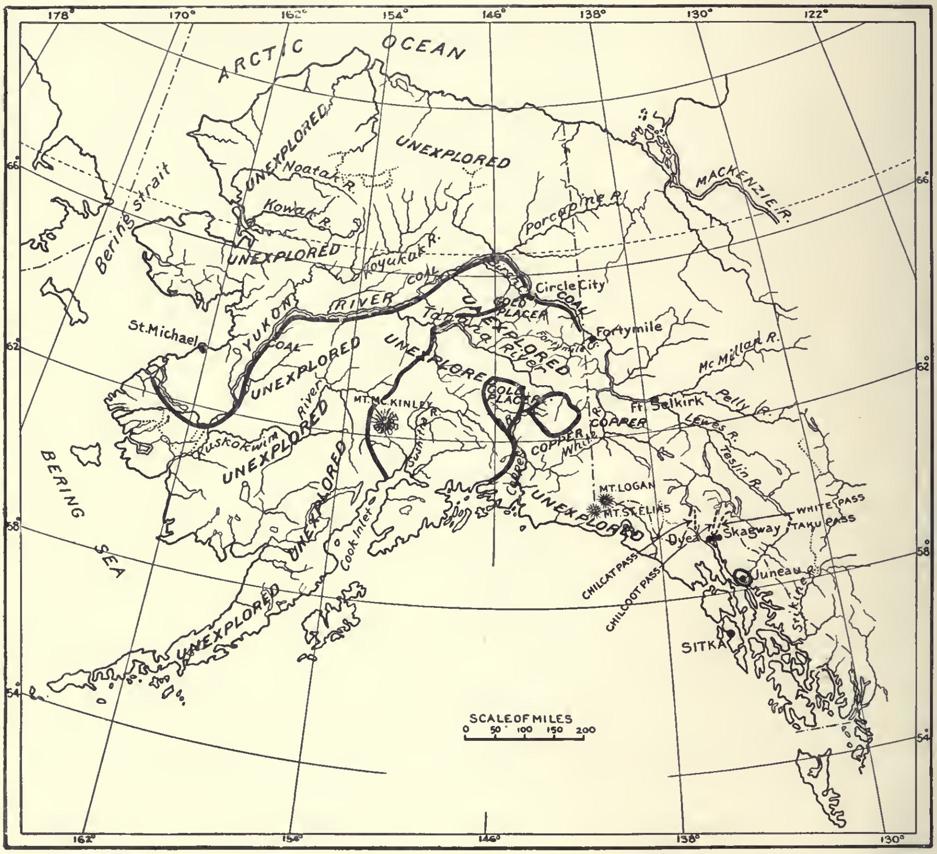
The most important topographic work as yet performed in Africa has been in Madagascar. General Gallieni, governor of the island since 1896, has adopted the methods used in the United States with such admirable results. He organized a survey of topographers and geodesists; in four years these officers have made charts of the great island based on a very precise triangulation. The scale is 1:1,000,000 and 1:500,000, and for central Madagascar 1 : 100,000. The maps, which are in colors, were engraved at Tananarivo, the capital, by a staff of natives. Scientific explorations have also been carried out in the south and southwest of the island by private individuals—MM. Bastard and Guillaume Grandidier—son of the famous explorer who is today President of the Société de Géographie of Paris.

In conclusion I must mention some of the French explorations in Africa in territory that does not belong to France: In Egypt, the work of "La Mission Archéologique d'Egypt," directed by the eminent egyptologist, Maspero; in Tripoli, the journey of M. Mèhier de Mathuisieulx (1901). This last explorer reports that the country from Tunisia to the great Syrte and to the south of this portion of the coast is sterile and only one-twentieth part inhabited. Sooner or later, of course, Italy will gain possession of this territory.

West of Algeria, Morocco is equally coveted by several European powers. The country is still but little known, due to the Mohammedan fanaticism of its inhabitants, who massacre Europeans as soon as they get a chance. Quite recently several Frenchmen have explored Morocco, notably Lieutenant de Segonzac, who traversed the Great Atlas mountains and the valley of the Sus.

In the opposite quarter of Africa, in Abyssinia, the European powers are displaying great political and scientific zeal to gain the alliance of Menelik. In 1900, the celebrated French writer, M. Hugues Le Roux, achieved some interesting work in the upper valley of the Blue Nile, and has told his story in a book as thrilling as a romance, "Menelik et Nous." Starting from Addis Abeba, Hugues Le Roux proceeded to the east across the mountains that separate the upper basins of the Aouache and the Omo and the Didessa. All this country he describes as exceedingly picturesque, even more beautiful than Switzerland.

The story of all these explorations is told or summarized in "La Géographie," the monthly magazine of the "Société de Géographie" of Paris. The chairman of its editorial committee is Prince Roland Bonaparte, a great grandnephew of Napoleon I. This illustrious geographer has accomplished many important scientific excursions, especially in northern Europe, where he has made some very noteworthy anthropological discoveries. He has been twice the president of the Société de Géographie. Prince Roland Bonaparte has visited the United States; probably when the International Geographical Congress meets in Washington in 1904, under the auspices of the National Geographic Society, he will again visit America to strengthen the ties of sympathy which bind French geographers and their colleagues in the United States.



Map Showing Unexplored Areas of Alaska. The heavy black lines indicate the proposed routes of the exploring parties from the Geological Survey in 1902

PROPOSED SURVEYS IN ALASKA IN 1902*

By Alfred H. Brooks, U. S. Geological Survey

SINCE 1898 the United States Geological Survey has been making systematic geologic and topographic surveys of Alaska. The annual appropriation by Congress for this work has been recently increased from twenty-five thousand to sixty thousand dollars in order to extend the investigation of Alaska's mineral resources. This increase has not been adequate to the needs of the work. The mineral interests have developed so rapidly in the past few years, and surveys in this distant province are so expensive, that it has been impossible with only sixty thousand dollars yearly to satisfy many of the urgent demands for work in various parts of the territory.

For three years past special attention has been given to the placer gold region of Nome, and the larger part of this area has been surveyed and investigated in some detail. The Koyukuk gold fields have also received considerable attention. In both of these fields, however, there is still much reconnaissance work to be done, besides the detailed work yet to be begun. Unfortunately, there is no money for the work to be carried on in these regions this coming season.

Southeastern Alaska is rapidly forging ahead in mineral production, and there are pressing demands on the Geological Survey for topographic and geologic surveys in this area.

During the season of 1901 it was impossible to continue the work of the previous year in the Copper River basin. in view of the importance of this area, it is deemed desirable to spend there a large part of this year's appropriation. The copper deposits of the Chitina River, a tributary of the Copper, have excited a great deal of interest among miners and capitalists. There have been many parties outfitted to prospect this region, and some preliminary development has been made. Prospecting has also been done in a second copper belt in the northern part of the Copper River and in the upper Tanana and White River basins. These two belts are to be the subject of special investigation during the coming season. The Chistochina gold fields, also included in the Copper River basin, have become important producers of placer gold. A survey of their entire area is contemplated. The surveys of the Copper River basin will also throw a good deal of light on the proposed railway route from Valdes to the Yukon River, and they will cover large areas which are believed to have value for stock raising and for cultivation.

The work in this region has been divided. One party will be in charge of Mr. F. C. Schrader, geologist, with Mr. D. C. Witherspoon, topographer, and the other will be in charge of Mr. T. C. Gerdine, topographer, with Mr. Walter C. Mendenhall, geologist. Mr. Schrader's party will map the upper Copper River basin and adjacent portions of the Tanana basin. They will connect the previous surveys of the Tanana River with those of the Copper and give special attention to the upper northern belt. Mr. Gerdine's party will map the Chistochina gold fields and will give attention to the southern copper belt, which was studied in 1900 by Messrs. Schrader and Spencer. The outfit and provisions for these two parties were shipped north in the latter part of February, and were transported across the coast range by a party led by Mr. D. C.

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* Published by permission of the Director of the U. S Geological Survey.

Witherspoon. It is hoped that by the time the sledding breaks up all of the provisions and supplies will have been carried in as far as Copper Center, or possibly as far as the mouth of the Chistochina River. Both parties will then have their base of supplies comparatively accessible to the areas which they propose to map. The rest of the party will start inland from Valdes in the early part of April.

It is hoped that these two parties will give us a topographic map of the entire Copper River Basin and a geologic reconnaissance of the greater part of it; also that definite statements can be made, after the completion of the work, in regard to the identity of occurrence of copper in the two belts running north and south of the Wrangell group. Mr. Schrader's party will also gain important geographic data concerning the rugged mountain mass known as the Wrangell group, which has been but little explored.

In making plans for Alaskan surveys two objects are kept in view: the one to investigate areas of known importance as to their mineral resources; the other to extend the general exploration work over the entire territory, toward the end of obtaining complete geographic and geologic knowledge, and possibly of finding new mineral producing areas. The Copper River work is planned for investigating a region which is now producing mineral wealth.

Another party, which will explore the northern slope of the Alaskan Range, will have for its more special purpose a topographic and geologic reconnaissance. It is proposed that this party shall leave Seattle about May 15, going by steamer to Tyonok, on Cook Inlet. From that point it will go westward toward the head of the Beluga River until it strikes the base of the mountain range; then, turning northward, it will cross through the mountains by the pass at the head of Skwentna River, explored in 1898 by Mr. J. E. Spurr. From the Skwentna Pass the route will lie along the northern slope of the Alaskan Range. As far as possible the range itself will be penetrated and topographic and geologic data gathered. If the plan is carried out as contemplated, important information should be obtained concerning Mount McKinley, whose altitude, 20,464 feet, was determined by Mr. Robert Muldrow in 1898.

Mount McKinley, which is the highest mountain on the continent, lies in the heart of the Alaskan Range, and no one has yet reached its base. Proceeding in a northeasterly direction, the party will cross the Tanana near the mouth of the Cantwell. If when this point is reached the season should be far advanced, the party will be under the necessity of shooting the horses and proceeding down the Tanana by raft. From the mouth of the Tanana the return to the coast can be made by way of Dawson and the White Horse. Should time permit, however, the party will cross the Tanana at the mouth of the Cantwell, and, heading in a northeasterly direction, will cross the Tanana and Birch Creek gold districts and reach the Yukon at Circle City. This latter route would give a chance of investigating the important and little known gold fields on the lower Tanana. The party will be under the leadership of the writer, with Mr. D. L. Raeburn as topographer, and five camp hands. It is proposed to use twenty pack horses to carry the outfit and supplies.

As the accessible timber along the Yukon is being exhausted, the matter of fuel supply in the interior is of growing importance. Coal is known to exist in many localities, and has been mined at some profit. Much is of an inferior quality, but some fairly good lignite has been found. With a view to investigating this coal supply, a party will be sent down the Yukon during the coming season. Mr. Arthur J. Collier, assistant geologist, will be in charge, and will be accompanied by two men. Mr. Collier will start at the international boundary and carefully study the Yukon section as far as the delta. He will make special investigation of such areas as are known to contain coal. He will also visit some of the placer camps accessible from the river which have not yet been investigated. This work is of particular importance from the standpoint of geologic correlation. Mr. Collier will have ample time to study the geologic relations in detail and to collect paleontologic data. It is believed that his work will throw considerable light on some of the broader stratigraphic problems of the territory.

Southeastern Alaska, embracing an area of about twenty thousand square miles, presents problems entirely different from those of the interior. The Coast and Geodetic Survey has completed the reconnaissance surveys of the coast line, but its detailed topographic work is limited to a few areas. As the mineral resources, consisting of gold, copper, silver, and nickel, occur in deposits which require large expenditures for underground mining, reduction works, etc., it is necessary, in this region, to carry on investigations in great detail, if they are to be of value to the mine-owners and prospectors. While the question of transportation is here much simplified because of the natural waterways, yet the dense timber and the heavy rainfall of the summer season make work in this region so difficult as to greatly increase the cost. Unless the appropriations are increased, it will take many years to map the most important mining districts alone. The Geological Survey, therefore, proposes to begin this work by mapping the Juneau mining district this year as a base for future detailed geologic studies. This topographic work will be in charge of Mr. W. J. Peters. The Juneau district is the most important in all Alaska, containing, as it does, the famous Treadwell mine.

We have a territory of nearly six hundred thousand square miles, and of this less than a sixth has been surveyed. These surveys have been chiefly of a reconnaissance character, and must be followed by mapping in greater detail. In view of the rapid development of the mineral resources, the immediate completion of the reconnaissance surveys and the initiation of the detailed surveys are a crying need. There would seem to be economy in such immediate furtherance of the important mining interests of Alaska.

OCEAN CURRENTS

BY JAMES PAGE, U. S. HYDROGRAPHIC OFFICE

EVERY method of investigation thus far employed, whether the drift of floating objects, the comparison of the temperature and specific gravity of specimens drawn from widely distant points, the distribution of animal organisms inhabiting different localities, all lend support to the belief that the vast mass of the surface water of the sea, and of the water some depth below the surface, even at a distance of thousands of miles from the continental shores, and hence far removed from local or tidal-current influence, is in motion ; and the continuity of this motion, in certain broad and well-defined regions such as the tropics, cannot but impress us with the idea that it is in a general way cyclical—that is, that the same water, after the lapse of time, retraverses approximately the same path.

The source of the energy required to set and keep this vast mass in motion has been productive of endless discussion. The attractive force of the moon, the *vis inertiæ* or lag of the water itself, the difference in temperature and specific gravity of the equatorial and polar regions, the unequal distribution of atmospheric pressure—each in its turn has been proposed and strenuously advocated as the true and only cause of the ocean currents. To the seaman, however, the cause of the ocean currents has always been the winds, the motion of the waters of the sea taking its origin in the region where the latter attain their maximum constancy, viz., in the region of the trades.

The trade winds cover a belt on the earth's surface extending roughly over 50 degrees of latitude, from 30° N. to 20° S., including within this belt a greater water area than could be included in any other position. Throughout this wide zone the wind blows for 90 per cent of the time from some point in the eastern semicircle. In the southern hemisphere the trades are somewhat stronger and more constant than in the northern, owing probably to the freedom from interrupting land areas. Over the eastern half of the ocean they extend far higher in latitude than over the western. This is true of both hemispheres, the northern and the southern, the northeast trades in the Atlantic during the northern summer often extending far up on the coast of Spain, the southeast trades during the southern summer often extending beyond the Cape of Good Hope. Similar conditions hold for the Pacific. The southeast trades, too, blow well across the equator into the northern hemisphere.

The trade winds, however, are not continuous throughout the entire belt from north to south. Just north of the equator and confined entirely to the northern hemisphere, extending east and west, is an elongated triangular area, the base of the triangle, in length some 15° of latitude, resting in the case of the Atlantic Ocean on the coast of Africa, in the case of the Pacific on the coast of Central America and Mexico, throughout which the trades are absent, their place being taken during a large portion of the year by light, variable winds and calms, during the remainder of the year by winds whose prevailing direction is southwest—the so-called southwest monsoon of the African and American coast, most apparent during July, August, and September.

THE CHARACTER OF THE TRADE WINDS

Among those who have not sailed in them the impression is general that the trades blow day after day steadily in one direction and with a constant force. This is distinctly not the case. The trade winds are quite as susceptible to variation, and fortunately so, as the winds of higher latitudes. The one thing about them is that, not being subject to the large variations of barometric pressure which characterize higher latitudes, the wind rarely goes around the compass and, indeed, rarely gets out of the eastern semicircle. As an example of their constancy, let us consider the percentage of winds coming from each compass point for a certain region, for instance, the square bounded by the parallels 20°–25° N. and the meridians 50°–55° W., in the heart, therefore, of the northeast trades in the north Atlantic. The figures are for the month of June, and may be regarded as giving the number of hours in each hundred, or, approximately, in 4 days, that the wind may be expected to blow from the given point:

June.....	20°–25° N...........	N.	1
	50°–55° W...........	N. N. E.	3
		N. E.	17
		E. N. E.	24
		E.	33
		E. S. E.	8
		S. E.	10
		S. S. E.	4

Other squares show similar variations; some greater, some less.

THE IMPULSE COMMUNICATED BY THE WINDS TO THE SURFACE WATER

Let us now examine the effect of such a system of winds in impelling through surface friction the water with which they come in contact.

If through any cause a thin layer of liquid is set in motion in its own plane with a given velocity, the layer immediately below it, and with which it is in contact, does not remain at rest, but likewise receives an impulse. This second layer exercises a like impulse over the third, the third over the fourth, and so on, the velocity ultimately attained by each successive layer being proportional to its distance from the bottom layer, which is supposed to be at rest. In the case of sea water, the rapidity with which this velocity is propagated downward is very slight. It has been calculated, for instance, that a period of 239 years would elapse before a layer at a depth of 50 fathoms would attain a velocity equal to half that at the surface, and for a surface current of given velocity to transmit its proper proportion of that velocity to a depth of 2,000 fathoms would require an interval of 200,000 years, the surface current flowing steadily all this time. Such surface currents do not exist, nor do winds capable of producing them. The trades, as we have seen, fluctuate from day to day and, indeed, from hour to hour, and the surface currents fluctuate in obedience to them.

It has been stated, however, that the fluctuations of the trades rarely carry them out of the eastern semicircle, and that in point of fact 90 per cent of the winds that blow in the region of the trades do come from that semicircle. There is thus always a westerly component in the motion of the air, coupled with a component which is sometimes northerly, sometimes southerly. For each alteration in the direction of the wind there is a corresponding alteration in the direction of the surface current, the new direction being the resultant of the old direction and the direction which would be imparted to it by the new wind acting alone. These, however, affect only the waters immediately at the surface. Thus, to cite a specific example, observations at the Adlergrund lightship, in the Baltic Sea, have shown that while the water at the surface responds almost immediately to a change in the direction of the wind, the water at the depth of 2½ fathoms does not feel its effects until an interval of 24 hours has elapsed. The steady westerly component is then the only one felt in the region of the trades at some little depth below the surface, and this is sufficient to impart to the entire body of water occupying the equatorial regions of the earth a westerly motion.

It is of some interest to note the velocity imparted to the surface water by winds of a given force. A comparison of a large number (658) of wind and current observations in the equatorial regions gave as the set imparted by a wind of force 4 on the Beaufort scale, corresponding to 20 miles per hour, a current velocity of 15 miles per day. The figures are taken from the "Meteorological Data for Nine 10°-squares of the North Atlantic Ocean," published by the Meteorological Committee of the Royal Society.

The system of surface currents produced by such a system of winds as the trades has been experimentally studied, using for this purpose a miniature ocean, the surface of the water being lightly sprinkled with powder in order to render its motion visible. As soon as the artificial wind was brought into action, a drift was created, and the first tendency was for the water to flow from all sides into the rear of the drift. This gradually extended itself in a sheaf-like form, the marginal threads in the fields untouched or only occasionally touched by the air current leaving the main body, first branching out to the right and left, then reversing their motion, and finally again working round to the rear of the drift. The central portion of the drift followed a right-line course, in close agreement with the direction of the air current, until a perpendicular obstacle was interposed. Here the drift divided into two streams, each flowing with the same velocity, but having half the cross-section.

This experimental system of currents finds its counterpart in nature. Under the northeast trades in the north Atlantic and the southeast trades in the south Atlantic, we find a broad central drift directed toward the shores of America, the drift from the southeast trades extending well into the Northern Hemisphere, the two uniting some distance off Cape San Roque. To the right and to the left of each of these drifts the water fringes off, the direction of the motion is reversed, and the so-called compensating currents manifest themselves. Along the equatorial margin of the two main drifts, under the equatorial belt of calms, these compensating currents unite to form the counter-equatorial current, or Guinea current, reaching a maximum intensity during June, July, and August, the months of the southwest monsoon. On the polar margin they either return into the drift or are taken up by the general easterly drift of the higher latitudes.

In the equatorial region of the earth we thus have in either ocean three currents. In the north Atlantic the north equatorial current, due to the northeast trades; in the south Atlantic the south equatorial current, due to the southeast trades; between these two the counter-equatorial current, flowing at all times, but reaching a maximum intensity and covering a maximum area at the time of the southwest monsoon. These first two are westbound, carrying the water toward the shores of America; the third is eastbound, carrying toward the shores of Africa. They all suffer a slight displacement with the season, in harmony with the movements of the trades, which oscillate slightly in latitude with the movement of the sun in declination. Also, in harmony with the fact that the meteorological equator lies slightly to the north of the geographical equator, the south equatorial current extends at all seasons well over into the northern hemisphere. Corresponding again with the fact that the southeast trades exhibit greater constancy and strength than the northeast, the south equatorial current shows higher velocity than the north, the average for the latter amounting to but 13 miles in 24 hours, for the former to 27 miles in 24 hours.

Similar statements hold for the Pacific Ocean. But from this point let us limit ourselves to the Atlantic, the currents for which are not only better known, but also probably better developed, being confined to a less extensive area than the Pacific.

In the Atlantic Ocean, then, the two drifts unite some distance off Cape San Roque, the eastern extremity of South America. A portion of the water is diverted to the southward, forming the Brazilian current; the main body flows west-northwest along the coast of South America, some entering the Caribbean Sea by way of the passages separating the Windward Islands, the drift through these passages often attaining a velocity of 50 miles a day. The remainder passes to the northward of the islands, forming the Bahama current. In this neighborhood a series of observations by Admiral Irminger, of the Danish navy, showed that the westerly drift of the water could still be detected at a depth of 900 meters.

A striking instance of the fluctuations of the surface currents with the winds is shown in the case of the straits separating the Greater Antilles, the Windward, and the Mona passage. From January to April, the months when the northeast trades are most northerly in direction and blow with maximum force, a strong southwesterly set is felt upon entering these passages. As the season advances and the trades weaken, at the same time becoming southeasterly, these currents diminish and change their direction to northwest.

Throughout the entire extent of the Caribbean Sea the drift is westerly, save that in those portions where resistance to the flow is offered, such as the southern coast of Cuba, return currents manifest themselves. Throughout the Yucatan passage the drift is northwesterly, but here again the influence of the return current is felt, notably under Cape San Antonio, the western extremity of Cuba, where southeasterly sets are frequent. In the Gulf of Mexico observations have thus far failed to reveal any decided set of the surface water.

THE GULF STREAM

Between the northern coast of Cuba and the Florida reefs starts the most celebrated of all ocean currents, the Gulf Stream. Discovered by Ponce de Leon in 1513, it has from that time been and still is the subject of scientific investigation.

In the Gulf Stream we have to deal with a current of a nature entirely distinct from those which we have thus far considered. These were all due to the direct action of the wind upon the water, producing a drift. The Gulf Stream is only indirectly due to this cause, being the overflow of the water heaped up by the trade-wind drift in the Caribbean Sea and the Gulf of Mexico. Throughout a considerable portion of its extent its direction, even at the surface, is independent of the wind or only slightly modified by it. The stream reaches its maximum strength at the point where it emerges from the Bemini Straits between the Bahama bank on the east and the coast of Florida on the west. The breadth of the actual current here between Fowey Rocks and Gun Cay Light is 38 miles, its average depth 239 fathoms, its average velocity 50 miles in 24 hours, although it rises at times to 100 miles. Farther north its breadth increases, and its velocity is correspondingly diminished. The western edge of the stream in its northward course along the coast of the United States follows closely the 100-fathom curve, although the axis of the stream, the line of greatest velocity, lies somewhat further seaward, its position varying, according to Pillsbury, with the declination of the moon, lying (at Jupiter) 8 miles farther off shore at time of low moon than at time of high. From Jupiter to Hatteras the axis runs at a distance varying from 11 to 20 miles outside the 100-fathom curve.

The color of the stream is a perceptibly deeper blue than that of the neighboring sea, this blueness forming one of the standard references of the nautical novelists. The depth of color is due to the high percentage or salt contained, as compared with the cold green water of higher latitudes, observation having shown that the more salt held in solution by sea water the more intensely blue is its color. Thus even in extratropical latitudes we sometimes observe water of a beautiful blue color, as for instance in the Mediterranean and in other nearly land-locked basins, where the influx of fresher water being more or less impeded, the percentage of salt contained is raised by evaporation above the average.

Another important fact in connection with the stream is its almost tropical temperature, due to the fact that its high velocity enables it to reach the middle latitudes with very little loss of heat. Upon entering its limits, the temperature of the sea water frequently shows a rise of 10° and even 15°. It was this fact that gave to the stream in the later years of the eighteenth century and the earlier years of the nineteenth an importance in the minds of navigators that it no longer possesses. In those days the chronometer, invented by Harrison in 1765, was still an experiment. Instruments were crude and nautical tables often at fault. The result was that the determination of the longitude was largely a matter of guesswork, a vessel after a voyage from the channel to America often being out of her reckoning by degrees instead of by minutes. The idea, first suggested by Benjamin Franklin, that the master of a vessel, by observing the temperature of the surface water, could tell the moment of his entry into the Gulf Stream, and could hence fix his position to within a few miles, was hailed with delight. The method was published in 1799 by Jonathan Williams in a work lengthily entitled "Thermometrical Navigation, being a series of experiments and observations tending to prove that by ascertaining the relative heat of the sea water from time to time, the passage of a ship through the Gulf Stream, and from deep water into soundings, may be discovered in time to avoid danger." In this work he makes the patriotic comparison of the Gulf Stream to a streak of red, white, and blue painted upon the surface of the sea for the guidance of American navigators.

The discovery of the stream is also alleged to have exercised a curious effect upon the commerce of some of our southern cities. In those days, when the only known sailing route was by way of the trades, it was the custom for vessels making the voyage from Europe late in the year to winter and refit at Charleston or Savannah before attempting to reach the more northern ports of Boston and New York, the prevalence of the northwesterly gales along the coast during the winter season rendering the passage a trying one even to the larger ships and with the better navigation of the present time. The southern cities thus became to a certain degree half-way houses on the voyage, greatly to the benefit of their trade. With the aid of a thermometer, however, a vessel once making the stream was enabled to remain in its midst and to be thus borne along by the current until the desired northing was made, after which she headed up for port. Thus the necessity for making Charleston or Savannah was obviated, and the advantage which they had hitherto enjoyed as commercial centers was lost.

From Hatteras the course of the stream leaves the coast in an east-northeast direction. It ceases to exist as a stream current—that is, as a current which runs independently of the winds—shortly after crossing the 40th parallel, and even previous to that, the current observations in the square bounded by 35°–40° N., 65°–70° W. (off the coast from Hatteras to Sandy Hook), showing for the month of maximum frequency (September) but 32 per cent of the whole number of observations setting northeast—*i. e.*, only 7 per cent more than 25 per cent, which would be the number if there were no directive influence whatever. In this latitude it becomes part and parcel of the general easterly drift which characterizes the waters of the ocean north of 35° in a manner quite analogous to the westerly drift of the tropics and due to the same cause, namely, the prevailing winds. In this latitude, however, the latter show none of the persistency of the trades.

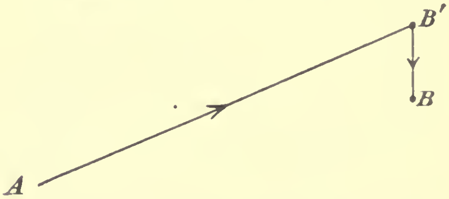
The winds of the North Atlantic Ocean, as also of the several other oceans—the South Atlantic, South Pacific, North Pacific, and the Indian—are governed mainly by the presence of an almost permanent area of high barometer covering the main body of the ocean, around which the winds constantly circulate, the circulation in the Northern Hemisphere being in the same direction as the hands of a clock, in the Southern Hemisphere in a contrary direction, or "with the sun" in either hemisphere, as it is expressed by sailors. In the North Atlantic the center of this area lies somewhat to the southwest of the Azores. On the southern slope of this barometric plateau the winds have an easterly direction—the northeast trades; on the northern slope, a westerly. These westerly winds, however, exhibit none of the constancy of the trades, being constantly interrupted by the wind systems proper to the alternate areas of high and low barometer which move across continent and ocean from west to east, and which form the governing feature of our own weather, the wind backing to the southeast with falling pressure, hauling to northwest with rising. Just as in the case of the trades, only to a much less extent; there is, however, a sufficient easterly component remaining to impart to the waters of the sea below the surface a distinct easterly motion, while on the surface itself there is apparently an utter lack of definite direction other than the fact that the direction of the current ordinarily agrees with the direction of the wind. How true this is may be gathered from a comparison of the observed winds and the observed currents for a given area; for instance, the 5° square included between the parallels 40°–45° N., 30°–35° W.—about in mid-ocean. The total number of wind observations recorded for the square was 8,898; of reliable current observations, 719. Dividing each of these up into quadrants and setting the current under that wind quadrant to which they are due, we have the following percentages:

	N. E.	S. E.	S. W.	N. W.
Winds	16	20	36	28
Currents	20	18	31	31

THE CONSTRUCTION OF CURRENT CHARTS

For our knowledge of the currents of the sea as tabulated in the current charts used by navigators—the movements of the waters as they actually take place—we are dependent upon ships' observations. When at sea the position of a vessel at noon of each day is determined by two independent methods. The first of these is known as the position by observation, and means, as its name implies, the position of the vessel as found by actual astronomical observation. The second is known as the position by dead reckoning, and is the position as found by reckoning up the vessel's progress from noon of the previous day, the compass giving the direction, the log the speed. In a majority of cases these two positions fail to agree. The astronomical position is then assumed to be correct, and the difference between them is set down as the current during the intervening 24 hours.

Thus let *A* be the position by observation at noon of a given day, *B′* the position by dead reckoning at noon of the following day—*i. e.*, the position derived from a consideration of the course and distance during the intervening 24 hours. Suppose, however, that astronomical observations show that the



actual position of the vessel at noon the second day is at *B*. In this case *B'B* will be set down in the log as the current experienced during the intervening 24 hours. In case no astronomical observations can be obtained, as happens in fog or cloudy weather, the position by dead reckoning has to be adopted as the best obtainable, with the result that if such weather continues for several days in succession, as sometimes happens at certain seasons of the year, the true position of the vessel may differ considerably from the assumed position, which is frequently accompanied with disaster upon approaching shore. To lessen this danger these current charts have been constructed, giving the results of current observations in the past, and the master of a vessel, by reference to them, is able to profit by the experience of those who have sailed over the same waters in previous years, and to some extent correct his own dead reckoning.

The current charts of the various oceans published by the British Admiralty—the charts which are universally employed by navigators—are the result of many, many thousands of observations—in fact, of all the reliable current observations taken since 1830. A glance at these charts will make plain the difficulty which confronts the navigator when approaching a dangerous coast, such as that of Newfoundland or of France, and compelled to rely upon his dead reckoning.

For a knowledge of the motions of the water throughout longer periods of time we are forced to depend upon the drift of floating objects, derelicts, wreckage, floating bottles bearing messages, and the like. Two attempts recently made to study the currents of the sea by this method deserve mention. The first is an effort to obtain a knowledge of the currents in the Arctic Ocean. Stout oaken casks, each one numbered and bearing a message, have been distributed by the Philadelphia Geographical Society among the whalers bound for the Arctic by way of Bering Sea, where they winter in the vicinity of the mouth of the Mackenzie River. These casks are to be placed upon the ice as far eastward as circumstances permit, and the expectation is that they will enter the Atlantic either by Davis Strait or Barents Sea, be noticed by passing vessels, and picked up. A letter from Dr. Bryant, the president of the society, states that 35 out of the 50 casks have been already set out, and that in his opinion they may be looked for on the other side of the circumpolar area about a year from the spring of 1902.

The second project is the proposed investigation of the current in the neighborhood of Ushant and Finisterre by means of floating bottles. This has been undertaken by Lloyds, the great ship underwriting firm, and has probably been brought about by the number of vessels lately lost in that vicinity, owing to the fact that they were out in their reckoning. The bottles, which are of gutta-percha, are to be sealed and thrown into the sea by passing vessels, each one containing a label showing the date and the position at which it was cast adrift. They are then supposed to drift ashore and to be recovered. The expense involved is considerable. On the bottle it is stated that a reward of five francs will be paid for the return to any of His Majesty's consuls—an instance of liberality of expenditure in the acquisition of knowledge which is almost unprecedented.

GEOGRAPHIC NOTES

FRENCH EXPLORATIONS IN AFRICA

THE article in this number on "Recent French Explorations in Africa" is the first of a series to be published in this Magazine from time to time on the geographic work of the great governments of Europe. France, Germany, and Russia are actively exploring their respective spheres in Africa or in Asia in their search for what will help them in a political or material sense. Much has been done during the past several years, but the story of the work accomplished has been for the most part buried in scattered government reports. It will be the aim of this series of articles to present briefly the main results of this work.

The admirable article by Dr. Charles Rabot gives an authentic summary of the plucky and persistent efforts of the French explorers in North Africa. The inspiring motive of nearly all these expeditions has been political, to join the disconnected members of her African colonies into a united empire. That France will get out of these lands all they have and will cost her in blood and money seems to us Americans improbable; but from a scientific and geographic point of view, the results have been enormous. Great blanks in the map of the continent have been filled in and much knowledge of country and wild inhabitants gained.

Dr. Charles Rabot is well known as the enterprising editor of *La Géographie*, a French geographic journal, the organ of the Société de Géographie of Paris.

MOUNT FORAKER

ABOUT 20 miles from Mt. McKinley, the highest mountain in North America, there towers another mountain believed to be only a few hundred feet lower. It was first seen by Capt. Joseph S. Herron, U. S. Cavalry, in the summer of 1899, and by him estimated to be about 20,000 feet high, or 464 feet less than the measured height of Mt. McKinley. Captain Herron named the mountain Mt. Foraker, in honor of the distinguished Senator from Ohio who had nominated William McKinley at each convention that made him the Republican candidate for President. Herron reports that Mt. Foraker belongs to the same range as Mt. McKinley. He made a sketch of it, showing its relative position to Mt. McKinley and the range. The sketch is published in his report. For several months he was within sight of the two mountains, and was thus able to make a good study of them both.

Captain Herron had been charged by the War Department with the task of finding an all-American route to the Yukon from Cook Inlet to Fort Gibbon. He started from Cook Inlet June 9, 1899, and spent six months on the journey of some 500 miles. He proceeded slowly, surveying and mapping the country very carefully as he advanced. His report, handsomely illustrated from photographs, has recently been published by the War Department (Adjutant General's Office, Bulletin 31).

ROCKY MOUNTAIN COAL-FIELDS

ALONG the east base of the Rocky Mountains there extends a belt, 1,000 miles long, from the Canadian boundary through Montana, Wyoming, Colorado, and New Mexico, 60 per cent of which are coal-fields. A similar though smaller belt stretches along the west base of the range through Wyoming, Utah, Colorado, and New Mexico. Mr. L. S. Storrs, of the U. S. Geological Survey, has recently made a special investigation of this coal area and estimates that in the Rocky Mountain region there are nearly 45,000 square miles of anthracite, bituminous, and lignitic-bituminous coal and 56,500 square miles of lignite. The results of the investigation are published in the twenty-second annual report of the Survey, part III, now in press.

Mr. Storrs believes the available coal of Colorado alone is thirty-four billion tons. The coals of Wyoming, lying largely in the plains region, are of a lower grade than the mountain coals of Colorado and Montana. The coal-fields of New Mexico have been explored only near the railroads, and those of Utah but little explored, so that no estimate can be formed of the coal resources of these two states. North Dakota's coal is lignitic and must be used very soon after leaving the mine, because it disintegrates so rapidly. There are no important coal mines in South Dakota. No careful exploration, however, has been made of the northwestern part of the state, where there is coal of more or less value. In Nevada coal of any value has been found only at one point, in the Eureka district. No coal is mined on a large scale in Idaho. In 1900, from the Rocky Mountain coal-fields 13,496,555 short tons were mined, worth about $17,400,000.

WORLD'S SUGAR PRODUCTION AND CONSUMPTION

A VERY timely bulletin has recently been issued by Hon. O. P. Austin giving the present statistical position of sugar. Fifty years ago about all the sugar consumed in Europe came from the tropics; from the West Indies, Louisiana, and the South American colonies in the Western Hemisphere, and from Java and parts of the East Indies in the Eastern Hemisphere. During the last half of the nineteenth century, however, the sugar-producing area of the world has been slowly shifting from the tropics northward to the temperate zone, due to the development of the beet-sugar industry. Practically all the countries of Europe are now engaged in the production of beet sugar. Spain, within the last five years, has developed a beet-sugar industry that supplies her home market and is now seeking for foreign outlets. Italy also within the last decade has made such progress in producing sugar that nearly two-thirds of the sugar used is produced within her borders. In 1900 Germany exported nearly one million tons of sugar—988,703; Austria-Hungary, 657,492 tons; France, 587,063 tons; Belgium, 300,757 tons, and Russia, 201,330 tons.

Two-thirds of the world's sugar supply is now produced from beets. Prior to 1871–'72 the world's production of beet sugar had never exceeded 1,000,000 tons for one year. In thirty years sugar produced from beets has quintupled, and for 1900 reached an estimated grand total of 5,510,000 tons. Meanwhile the sugar produced from cane has not quite doubled in quantity. In 1871–'72 the estimated production of cane sugar was 1,599,000 tons, while in 1900 it had reached a total of 2,904,000 tons.

The Coast and Geodetic Survey has just published a chart showing the lines of equal magnetic declination and of equal annual change in the United States for 1902. The chart is based on all known observations to date.

A topographic map of Philadelphia and vicinity has been recently issued by the Geological Survey. The map shows the city and suburbs on the south and west, and connects with another map, also just published by the Survey, showing the city of Chester and surrounding country to the Delaware line. The Survey had previously issued two sheets of the Norristown and Germantown suburbs, so that by mounting the four sheets together an excellent map of the Philadelphia region may be obtained.

Dr. George Davidson has published an exhaustive treatise, with map, on "The Tracks and Landfalls of Bering and Chirikof on the Northwest Coast of America," from the point of their separation, in latitude 49° 10′, longitude 176° 40′ west, to their return to the same meridian—June–October, 1741.

Geographic Work in the Philippines.—Plans are being matured for extensive explorations in Mindanao, Mindoro, and Luzon. Of the two first-named islands practically nothing is known except the coastline. The work will be under the personal charge of Dr. David P. Barrows, chief of the Bureau of Non-Christian Tribes, P. I. Dr. Barrows is now in the United States, but on his return to Manila early in April will immediately enter the field. Mindoro is about twice the size of the state of Delaware, Mindanao is larger than the state of Indiana, and Luzon nearly as large as the state of New York.

Stretching from north to south across Luzon on either coast are parallel mountain ranges. The low country between the ranges is comparatively well known, but the mountainous region is unexplored, and little is known of the unchristianized tribes living there. The special object of the Bureau of Non-Christian Tribes is to study the natives of the islands who are not Christians and have not been under Christian influence.

The Wealth of Nations.—The London *Daily Mail* year book for 1902 estimates the wealth of the United States as nearly equal to the combined riches of France and Germany, as three times that of Russia, and about twenty-two billion dollars more than the wealth of Great Britain. In round numbers the wealth of the United States is figured at $81,650,000,000; of Great Britain, $59,030,000,000; France, $48,450,000,000; Germany, $40,260,000,000, and Russia, $32,125,000,000. The per cent of debt to wealth of these nations is estimated for the United States, 1.4 per cent; United Kingdom, 6 per cent; Germany, 8.1 per cent; Russia, 11.1 per cent; France, 12.8 per cent.

The original map made by George Washington in 1775 of the lands on the Great Kanawha River, West Virginia, granted to him by the British Government in 1763 for his services in the Braddock Expedition, is now in the possession of the Library of Congress. Mr. P. Lee Phillips, Chief of the Division of Maps and Charts, who recently obtained the map for the Library, has placed it on exhibition, where it can be seen by the many thousands daily visiting the Library. The map is about two by five feet, and is entirely in the handwriting of Washington. The margin is filled with notes, also in Washington's handwriting, describing the boundary marks set by Washington and different features of the tract.

"The Journal of School Geography," so successfully directed for many years by Richard E. Dodge, Professor of Geography in Columbia University, and "The American Bureau of Geography," of which Edward M. Lehnerts, Professor of Geography in the State Normal School of Minnesota, was the able editor, have joined forces, and will hereafter be issued as one publication. The title of the new magazine is "The Journal of Geography." It is planned "to meet the needs of all the teachers and students in geography." The journal, which will be issued ten times a year, is edited jointly by Professors Dodge and Lehnerts and J. Paul Goode, Professor of Geography in the University of Pennsylvania.

The First Crossing of Samar.—It has been repeatedly stated in the press reports recently that the first crossing of the island of Samar by Americans was made several weeks ago by Major Waller, of the Marine Corps. As a matter of fact, the island had been crossed several times previously by American officers and troops. For instance, the Military Information Division of the War Department has now in press a map showing several route sketches across Samar surveyed by Lieut. W. S. Martin from June to September, 1901. This map shows six distinct trails across the island. The scene of Waller's crossing was the southwestern corner of the island. A dense, impenetrable forest jungle covers large portions of the island. The jungle is so dense that even the natives are ignorant of what it hides.

The Peary Arctic Club has reëlected its present officers for the year 1902: Morris K. Jessup, president; H. W. Cannon, treasurer, and Herbert L. Bridgman, secretary. In July the club will send the *Windward* northward to take supplies to Mr. Peary and probably to bring him back in the fall. Mr. Peary is now leading his fourth consecutive campaign against the North Pole. In 1899 he reached Fort Conger, being the first to visit Conger since General Greely left it in 1883; in 1900 he rounded the Greenland Archipelago, perhaps the most important of all the important work he has done; in 1901 he again reached Fort Conger, but advanced only ten days beyond that point. This spring Fort Conger will again be his base and Cape Hecla his starting point for the Pole.

GEOGRAPHIC LITERATURE

The Mastery of the Pacific. By Archibald R. Colquhoun. With maps and illustrations. New York: The Macmillan Co., 1902.

Mr. Colquhoun has written many volumes, but probably none of them will command as widespread interest and attention as his latest book, "The Mastery of the Pacific." He has visited the Philippines, Australia, and New Zealand, and also lived for considerable time in China and Japan and in California, studying the life and peoples bordering the great ocean, for he has long believed that in the arena of the Pacific "will occur the great struggle of the twentieth century." The present volume aims successfully "to present a vivid impression of the various countries, their peoples, scenery, social and political life, and the parts they are destined to play in the great drama of the mastery of the Pacific."

One hundred and thirty pages are devoted to the United States in the Pacific, 130 pages to Great Britain in the Pacific, 80 to the Dutch, 36 to Japan, and 20 to Germany, France, Russia, and China. To Americans Mr. Colquhoun's observations in the Philippines are specially interesting.

The American plan "to fit the coming generation for its future" by education of the most advanced type Mr. Colquhoun pronounces "a beautiful theory and a beautiful scheme, but unfortunately it involves an entire subversion of the laws of nature." The Filipino is not simple and amenable, but a half-civilized, clever, irresponsible child, with warped ideas of right and wrong. "If unnaturally stimulated, he may grow up into a Frankenstein."

The great danger is that by a wholesale education a great mass of half-educated Filipinos will be developed, who will be restless, discontented, and conceited, and turn against the government unless provided with offices. The Filipino loves the abstract—the theoretical side of learning; he will talk fluently about the principles of individual rights, but what these rights are in practice he does not know, and if they were given to him he would not recognize them.

There are many openings for capital in the Philippines, but very few for the individual without money. "This is no poor man's country; no place for the individual digger—the climate and cost of living preclude that—and it is to be hoped that the government will be able to prevent the influx of a large number of unemployed. Already mean whites are abundant and on the increase."

Everything considered, the Americans have begun well. Judge Taft "has won golden opinions from every side," and "is peculiarly the stamp of man to deal successfully with the Philippines."

Irrigation in the United States. By Frederick Haynes Newell, Hydraulic Engineer and Chief of the Division of Hydrography of the U. S. Geological Survey, etc. With many illustrations and maps. New York: T. Y. Crowell & Co., 1902. $2.00.

Mr. Newell, the chief of the Irrigation Division of the U. S. Geological Survey and the foremost authority on all matters relating to irrigation in this country, portrays in this book the conditions confronting man in the arid region, the character of the lands, the rainfall, and the available water supply. He describes the methods of stream measurement, the construction of irrigation works, the application of water to land, the occurrence of underground supplies of water, and the methods of raising it. Irrigation laws and the practice in different states are set forth clearly and simply. The work closes with descriptions of the states in the arid and semi-arid regions. It is a clear, simple, and full presentation of the subject addressed to the general public, to settlers and intending settlers in our arid regions rather than to technical experts.

One-third of the area of our country is dependent upon artificial watering for success in agriculture. With a wise application of the available water, many millions of people can find homes therein. Without water it is well-nigh valueless for home-making.

The theme of the book is the aphorism that in the arid region it is water, not land, that creates values. Of the arid region only about one per cent is now utilized through irrigation. It is estimated that there is sufficient water to reclaim ten times that amount, if properly applied. Land is abundant, water is scarce and precious. At present, nearly all the water that can be applied to land at small expense has been utilized. Future works of reclamation must be upon a large scale, and can best be done by the National Government. Under the plan, which is now before Congress, it is proposed that the Government construct the works and sell the water and lands to settlers at cost.

The increase in our arable area and consequent increase in our agricultural population, resulting from a complete utilization of our water supply, will benefit and strengthen our whole people, east as well as west, for the prosperity of one section increases the prosperity of all.

The illustrations merit special mention. The half-tones are admirably selected and well reproduced. The maps and diagrams are simple and yet wonderfully effective.

Scotland. Historic and Romantic. By Marie Hornor Lansdale. Illustrated. 2 vols. Philadelphia: Henry T. Coates & Co., 1902.

The best part of these volumes is the unusually fine illustrations. The text is random, disconnected, and incomplete. The reader would infer from the description that the chief interest of the great castles and palaces is that the Earl So-and-So or the Bishop So-and-So was imprisoned, tortured, or beheaded in such-and-such a building. What they fought and died for is usually left to the reader to supply. Those who visit Scotland merely to see the historic fortresses and hear the grewsome tales which cling to each should take these volumes with them.

Wonderland, 1902. By Olin D. Wheeler. Illustrated. Published by Charles E. Fee, Northern Pacific Railway, St. Paul.

This handsome little book of 100 pages describes that part of the northwest which is tributary to the Northern Pacific Railway. The leading chapter tells the story of mining in Montana from the early sixties to the present; there are also chapters on the Northern Cheyenne Indians, the Yellowstone Park, and the Puget Sound country. Several hundred beautiful pictures are artistically arranged in the text. The publisher announces that the book will be sent to any address upon receipt of six cents, the cost of postage.

The Scenery of England. By the Right Honorable Lord Avebury (Sir John Lubbock). With illustrations. New York and London: The Macmillan Co. 1902. $2.50.

The author does not attempt to describe the scenery of England, but rather to explain wherein the rivers and hills, the moors and fens, and the great cliffs of the coast have had their origin. In other words, he does not directly tell what the country is, but how it has become what it is. The book is thus, in a certain sense, a geologic history of England. It is written in Lord Avebury's terse and pointed style, and is an exceedingly valuable work. Some of the chapter headings are "Geology," "The Coast," "The Origin of Mountains," "Volcanoes," "The History of a River," "Influence of Rocks upon Scenery," and "Downs, Wolds, Fens, Moors, and Commons." Rarely has any book of this character contained such graphic and real illustrations of the results and working of the different forces of nature.

Touring Alaska and the Yellowstone. By Charles M. Taylor, Jr. With illustrations. Philadelphia: George W. Jacobs and Company.

Mr. Taylor describes merely the ordinary tourist's trip by the Canadian Pacific road from the east to Seattle; thence by the steamer *Queen* to southeastern Alaska, and by rail from Skagway to White Horse, on the Yukon. The return journey was made by the Northern Pacific road, stopping a few days in the Yellowstone Park. The book is written in a bright, interesting manner, and the numerous illustrations are well selected and excellently reproduced.

China and the Allies. By A. Henry Savage Landor. Two volumes. Illustrated. New York: Charles Scribner's Sons, 1901.

The story of the Boxer uprisings and of the massacres and horrors of the months that followed are graphically told. It makes rather superficial reading, however, and beyond much excitement the reader gains little. The volumes are very handsomely illustrated.

Eastern Peru and Bolivia (H. H. Hill Publishing Company, Seattle) is the title of an interesting little book of 50 pages, giving some of the experiences in that country of William C. Ogle, a Yankee engineer who has prospected and worked gold mines all the way from Alaska to Bolivia.

NATIONAL GEOGRAPHIC SOCIETY

PROCEEDINGS

Meetings of the Society:

March 7, 1902.—President Graham Bell in the chair. The proceedings of the last meeting were read by Secretary Henry and approved.

"The Petroleum Resources of the United States" was the subject of an address by Dr. C. Willard Hayes and of the discussion following. Dr. Hayes briefly explained the composition of the hydrocarbons and outlined the several theories of the formation of petroleum—the organic theory, the inorganic hypothesis, and the theory that petroleum is formed by inorganic substances acting on organic substances. Petroleum in Pennsylvania is found in sandstone which looks so massive that at first sight it would seem to be solid; in Ohio it is found in the Trenton dolomites, and in Texas in porous and vesicular rocks. The age of the formations containing petroleum varies from Silurian in Ohio and Carboniferous in Pennsylvania to Neocene in California.

There are no surface indications to indicate where petroleum exists. Certain characteristics of rocks, however, must be present. The rocks must be porous, they must have good cover (*i. e.*, must be overlain by an impervious stratum), and they must be flexed. The geologist can tell with certainty where oil will not be found; he can also tell where it may be found, but he cannot tell definitely where it will be found.

Dr. Hayes called attention to the peculiarity of the land at Beaumont, Texas. All wells drilled in the top of a sharp dome yield oil, but any holes drilled in the side of the dome yield no oil. As an instance of the great pressure of the oil at Beaumont, Dr. Hayes cited one well where, at a depth of 1,700 feet, the pressure was from 700 to 800 pounds to the square inch. He also called attention to the widespread use of oil as a fuel in some manufactories in the South, where it was found that one man could do the work of nearly fifty in the furnace-rooms.

The output of petroleum has more than doubled for the United States in the last 20 years. In 1880 the output was 26,286,123 barrels, and in 1900 it reached the enormous total of 63,362,704 barrels. Considerably more than half of the petroleum produced comes from the Appalachian field and about one-third from Ohio and Indiana.

Dr. Hayes said he wished especially to emphasize the fact that the supply of oil was not inexhaustible, but limited, and that unless the great waste at present was checked there would be an exhaustion of petroleum at no distant day. When gas was discovered the supply was thought to be unlimited, but already the natural-gas fields of the country have been practically exhausted. At least 1,000,000 barrels of oil have been wasted in one year at Beaumont. Such wasteful extravagance ought to be corrected if the oil is to last.

At the conclusion of Dr. Hayes' very interesting address President Bell called for remarks.

Prof. A. J. Henry mentioned the practice, common in certain parts of Ohio, Pennsylvania, and New York, of pumping abandoned wells at intervals, which is a quite profitable business when the price of oil is high. He also directed attention to the fact that presence of gas does not indicate that oil is to be found in the vicinity.

Mr. R. U. Goode inquired as to the relative price and value of oil found in the different fields.

Dr. Hayes remarked that the price depended upon what you could get for it. Beaumont oil sells for from 10 to 25 cents a barrel on the field; Pennsylvania is worth 90 cents a barrel, California 65 cents a barrel, and Texas 50 cents a barrel, or 75 cents if coal in the neighborhood is selling for $2.50 a ton.

Vice-President McGee called attention to the fact that young formations are richer and old formations poorer in hydrocarbons, instancing marsh gas as an illustration of contemporary origin of the substances. Dr. McGee also stated that the dome structure noted in Texas and elsewhere is not found in California, and inquired what was the mode of the accumulation of the oil in California.

Dr. Hayes, replying to the question as to whether any oil had been discovered in the West Indies or the Philippines, said that small quantities of a very pure oil had been found in Santa Clara, Cuba The peculiar fact of this oil was that it was associated with rock of igneous origin. So far as he was aware, there was no further developed field elsewhere in the West Indies. There was said to be some oil in the Philippines. The Appalachian oil field is the largest in the world, in extent greatly exceeding the Russian fields at Baku.

Dr. David P. Barrows mentioned the fact that in the Far East oil from Sumatra is extensively used, and there was also oil in Java.

Prof. C. C. Georgeson inquired as to the process of refining petroleum.

Dr. Hayes replied that he had not investigated the refining process sufficiently to consider himself competent to speak on that subject.

Mr. G. K. Gilbert believed that the speaker had given undue weight to the inorganic theory as to the formation of petroleum, inasmuch as there was no observational basis for this theory. Inorganic materials, as far as we know, do not exist in combined form on the earth's crust. They may exist in combined form, but we know of no instance Mr. Gilbert also alluded to the growing custom of using oil for laying dust in road-beds of railways and in the streets in southern California.

The President referred to some oil fields in California which were beneath the surface of the water. The wells are drilled some distance from the shore. Dr. Bell also alluded to a neighbor of his in Cape Breton, Nova Scotia, who drilled an artesian well and obtained a small quantity of refined oil! At one time there was great excitement in Nova Scotia over the supposed existence of much petroleum there, but it turned out that there was no oil at all, except in some rare instances.

LECTURES :

March 12.—Vice-President McGee in the chair. Afternoon course.

Prof. E. F. Fenollosa, of the University of Tokio, gave an illustrated address on "Problems of the Pacific—Japan," which will be published later.

March 14.—President Graham Bell in the chair.

Dr. Charles H. Townsend, U. S. Fish Commission, gave an illustrated address on "Ocean Bottoms."

March 19.—President Graham Bell in the chair Afternoon course.

Mr. Henry Demarest Lloyd gave an address on "Problems of the Pacific—New Zealand," which will be published later.

ANNOUNCEMENTS

ANNUAL EXCURSION ;

The Annual Excursion of the National Geographic Society will this year be to Gettysburg, Pennsylvania, on Saturday, May 17. By special arrangement with the Pennsylvania Railroad, the round trip ticket from Washington to Gettysburg will cost $2.25, provided 200 members and friends join the excursion. (The price of the regular round trip ticket is $5.60.) Luncheon persons may carry with them or buy at Gettysburg for a moderate sum. The Committee on the Annual Excursion, consisting of Col. Henry F. Blount, Mr. F. V. Coville, and Mr. Raymond A. Pearson, request that all members who intend to take part in the excursion, or who have friends desiring to join the party, should send their names, with the number of tickets they desire, to the Secretary of the Society as soon as possible. To secure the special train and the special fare, the Society must guarantee 200 tickets. Other details of the excursion, such as the time of departure of the train, etc., will be announced later. An interesting programme of addresses, to be given on the field of Gettysburg, is now being arranged by the Committee. It is earnestly hoped that many members of the Society resident outside of Washington may find it possible to join the excursion at either Gettysburg or Washington.

MEETINGS OF THE SOCIETY :

April 4.—Work of the Bureau of Forestry :

Development, Organization, and Policy of the Bureau of Forestry, Gifford Pinchot.

Division of Forest Management ; Forest Working Plans ; Scope of Work, O. W. Price.

The Arkansas Tract ; A Specific Working Plan ; Problems Involved, F. E. Olmsted.

Division of Forest Investigation ; Scope of Work ; Notable Investigations, Geo. B. Sudworth.

Section of Tree Planting ; Scope of Work ; Tree Planting, Wm. L. Hall.

April 18.—Results of recent Hydrographic Surveys :

Introductory Remarks, F. H. Newell.
Work in Arizona, Arthur P. Davis.
Work in Colorado, C. H. Fitch.
Work in Montana, Cyrus C. Babb.

LECTURES :

April 2.*—"Problems of the Pacific—The Commerce of the Great Ocean." Hon. O. P. Austin.

April 9.*—"Problems of the Pacific—The Great Ocean in World Growth." Vice-President McGee, LL. D.

April 11.—"Explorations in Antarctica." C. E. Borchgrevink.

April 25.—"Our Northern Rockies." Robert H. Chapman.

President Graham Bell has appointed the following committees of the Society :

Technical Meetings.—Richard U. Goode, G. W. Littlehales, Isaac Winston.

Annual Excursion.—Henry F. Blount, F.V. Coville, Raymond A. Pearson.

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* Columbia Theater, 4.20 p. m.

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THE NATIONAL GEOGRAPHIC MAGAZINE

RECENT EXPLORATION IN THE CANADIAN ROCKIES

BY WALTER D. WILCOX

BETWEEN the United States boundary and the Canadian Pacific Railroad lies a part of the Rocky Mountains which remains unexplored. Captain Palliser, searching for a pass across the Rockies, went through the northern part of this region half a century ago, but traveled so rapidly that his notes, even on the part he visited, have almost no geographic value. This large area, which is a blank on Dawson's map, represents more than 2,000 square miles in the main range of the Rockies. Many tributaries of the Elk and Kootenai Rivers rise in this unknown region. Of these the Bull River, a torrent too wild to be crossed on a raft and too deep to ford with horses, descends from the southern part, its canyons and timber-choked valley having defied every attempt to find its source.

Last summer Mr. Henry G. Bryant and the writer made an expedition with the purpose of exploring this region. We planned also to make on our way south an ascent of Mt. Assiniboine, a conspicuous and superb peak of the main range. In the latter attempt we were defeated. One of our Swiss guides was bucked off a pony and his arm dislocated on the way to the mountain's base, and we had the further misfortune of three days' stormy weather, which covered the mountain with snow. We, however, reached a point 11,000 feet above sea-level on its southern slopes, where we were compelled to turn back by avalanches falling continuously on every side.

Four days later we reached our main camp, near the forks of the Spray River, 20 miles south of Banff. Here we dismissed the two Swiss guides, and gave them saddle horses and escort of one of our men to a point within walking distance of the railroad. The two other men were sent to cut out the trail for the first day's march.

A description of our outfit and general plan is here advisable. Our Indian ponies—fourteen in number—two tents and Indian teepee, with sufficient provisions for a long and hard journey, were supplied at Banff by T. E. Wilson. Our men were Tom Lusk, James Wood, and Ben. Woodworth, the two former serving as packers and the latter as cook.

Photo by Wilcox

Spray River near the Forks

No better selection of men could have been made. Each could serve well in the capacity of cook, packer, or axeman. Subsequent success was partly due to completeness of equipment and the efficiency of our men.

Our general plan of exploration was to proceed directly south from the White Man's Pass and make the Kananaskis Lakes our first headquarters. It was then our idea to follow the Elk River southwards and explore the unknown streams which come out of the high range of mountains on its west side. Circumstances entirely changed this order of travel and added a decided interest to our movements without in any way defeating geographical work.

Our scientific equipment was simple. It consisted of a prismatic compass and Abney's level, two aneroid barometers, thermometer, and three excellent cameras for tripod work, panoramas, and snap shots. We also carried a King folding boat for exploring the Kananaskis Lakes and crossing rivers.

No weather could have been more perfect than that of August 4, the day after our guides were sent back and we were to set out for the unknown south land. The sky was perfectly clear and the mountain air invigorating as we commenced marching. Two branches of the Spray River run north into the great transverse rift called the White Man's Pass, and of these we chose to ascend the more westerly, as it was not mapped and would lead us at once into unexplored territory. On Dawson's map this valley bears the words "trail to the Kananaskis Lakes." We set out with full assurance that in four days at most we should reach these lakes, and in an hour had left the main valley and turned sharply to the southeast. A good Indian trail led us through deep spruce woods for two miles and then entered a very beautiful valley. The lower levels are too wet for forest growth, so that splendid views were to be enjoyed in every direction. The mountains on the east are from eight to nine thousand feet high, with very rough outlines and vertical precipices toward the north. Those on the other side are higher and have small glaciers on their upper parts. The wooded slopes and open glades of the valley, thick with clumps of dwarf birch and willow, together with the winding and picturesque stream, made our introduction to the new region most inviting.

About one o'clock a valley opened to the south which seemed worthy of exploration, and we accordingly made camp on a wooded ridge between the confluent streams. Later in the day Bryant and I started on foot to investigate this opening. The small size of the stream indicated a summit or pass not far distant. We found the walking very rough over a succession of small, wall-like ridges covered with thick woods and charming meadows between crowded with wild flowers. A foamy stream led us to a green pool, the upper end of which was overhung by vertical cliffs of limestone. These cliffs made the end of a small canyon, which led us in half a mile to a blue-green lake three-fourths of a mile long. This we decided to skirt, fortunately by the right shore, where we soon found a good Indian trail which traversed the steep, open slopes above the lake, covered with mountain flowers in the height of perfection. A rank growth of false hellebore and cow parsnip rose above

Photo by Wilcox

Canyon Lake

our heads, while the ground was concealed by beautiful asters, white geraniums, meadow rue, and forget-me-nots. In contrast to this picture of summer, one cove of the lake was filled by a snow bank at the water's edge, remaining unmelted from the previous winter.

The upper end of this lake is dotted with small islands. An open glade extends to the summit of a pass not half a mile distant. It is 6,100 feet above sea-level—very little higher than the lake. Descending a short distance we saw a green valley running almost due south into the heart of an unknown country, which should prove an interesting point of departure for some future exploration. This pass is on the continental watershed, and hence on the boundary between the Northwest Territories and British Columbia. An unusually gentle ascent makes the approach easy from the east, and the trail indicates that the Indians have used this as a route to the Kootenai. The pass is 600 feet lower than the height accredited by Dawson to the White Man's Pass, which lies five or six miles farther north.

Photo by Wilcox

" We continued our march up the main valley "

The remarkable feature of the lake

Photo by Wilcox

Approaching a Rough Country

near this pass is that there is no apparent outlet into either valley. The narrow canyon, now partly filled with large masses of rock from its own walls, gives without doubt an underground passage for the water, but it would be hard to explain how the water first cut through a high ridge when the drainage seems more natural in the other direction.

We continued our march up the main valley next day. An early start was made on account of the "bulldogs," a kind of horsefly, which were remarkably numerous in this picturesque and interesting valley. They are most numerous on hot, sunshiny days, but fortunately do not appear till several hours after sunrise. Their bite is like a fiery spark, which drives horses frantic, so that it is almost impossible to pack them after these ferocious pests have made their appearance in force.

An Indian trail ascends the main valley through a quite level country with sharp peaks on every side. The most imposing lies to the southeast, and appears nearly 11,000 feet high. Toward this we marched at three miles an hour, the maximum rate for a heavy pack-train. A sudden termination to easy progress and pleasant surroundings came at length near the valley end, where a sharp ascent through burned timber brought us, at 11 o'clock, to the pass summit, 6,690 feet above sea-level. The summit is nearly level for about two miles, and dotted with several shallow lakes of marvelous colors. The encircling mountains, with their glaciers and waterfalls, made the scenery interesting, but we were disappointed to catch glimpses of a desolate, burned valley ahead which looked very rough. We were forced to make several exceedingly steep descents into this new valley, which runs southeast, and which we thought was the Kananaskis. Our pack animals showed great skill in jumping logs and selecting safe routes, and after six hours of hard work camp was made near a large stream which enters from the east. The altitude here was 4,980 feet, considerably below Dawson's estimate for the Kananaskis Lakes, a fact that made us first suspect that we were not in the Kananaskis Valley. The tents stood on a former Indian camping ground, and in fact our men used their poles to stretch the teepee. At this place we overlooked a trail of great importance. The narrow and wild valley opposite our camp, with its muddy torrent, which indicated a glacial source, seemed a most unlikely place for an Indian trail. Moreover, the vast multitude of logs and the rank growth of false hellebore, standing seven or eight feet high, and other weeds, sufficiently disguised the already faint trails and led to a complete change in all our subsequent movements.

Though the weather remained clear a strong wind swept clouds of smoke from forest fires into the valley and added to the dreary aspect of our surroundings. However, a slight change in the direction of the wind during the night moved the smoke clouds a great distance to the south and proved that the fire was not nearer than the Kootenai Valley or Selkirk Range.

The march next day developed no change until after about five miles of very rough country had been covered. A large stream then came in from the west, and the valley is wider, with open gravel beds for many miles. We had now given up the idea of finding the Kananaskis Lakes in this valley, which we thought must be that of the Palliser or some tributary thereto. Steady progress was made by marching over the waterworn stones, which were very trying to our ponies, and fording the river constantly. Meanwhile a constant outlook was kept for some opening on our left that might be the Kananaskis Pass. Nothing appeared till about noon, when a gap was disclosed in the hitherto unbroken range of mountains to the east. As we drew nearer, the gap seemed to close again, and a more promising opening was seen about three miles down the valley. We had, however, already come too far south, and it seemed best to camp here and investigate. Though there was not much grass for our horses, a partial compensation was felt in the almost total absence of the bulldog flies which had made the charming country near the source of the Spray River almost unendurable, and there was, as is almost universally true in the Canadian Rockies, an abundance of firewood and excellent water for our camp. Proof that the country abounded in game was given by the presence of wooden frames used by the Indians for scraping and drying the hides of mountain goats and other animals.

The afternoon was spent in a general reconnaissance. Tom Lusk was sent downstream to investigate the first valley on the east. Meanwhile Bryant and I made a direct line through the woods toward the gap which we had seen. We soon came to a canyon and a large stream, which descends from a green valley above. A steep mountain of moderate height appeared ahead, and I proposed to climb it to get a better view of the surrounding region, but Bryant did not think it worth while, and turned back. In an hour I reached 5,700 feet, but could not safely go farther on the almost precipitous limestone cliffs. I got a fine view and made a sketch of a promising green valley which runs south and ends in some high red hills.

As no trail had been discovered in the canyon, we felt confident that Lusk's trip would give better results. He returned later, however, and reported that there was no evidence of a trail in the first valley on the east, and that it seemed quite impassable for horses. This was our first geographical problem. To follow the uninteresting Palliser River farther seemed fruitless, as it was now bending away toward the west and becoming so large as to give us trouble in fording it. After some discussion a decision was reached to spend the following day in a more thorough reconnaissance.

August 7, like every day of our trip so far, was almost perfect. Lusk and Wood were sent down the river to explore as far as the second or third valley openings, while Bryant and I decided to ascend the canyon near our camp and climb some high mountain, if accessible. Upon entering the canyon we made slow progress among great boulders and tree trunks strewn in wild disorder on either side of a torrential stream, which was little less than a series of cascades. At length the canyon walls forbade farther progress on our side and we were forced to find a way to cross the stream. Fortunately some massive spruce trees had been jammed by a former flood among the boulders on either side and made a kind of natural bridge not far ahead. Crossing on these, we had gone but a few steps when we came most unexpectedly on a good Indian trail. Here, then, was the Kananaskis Pass at last. So confident did we feel of being now on the right route that we should have gone back to camp at once and packed up for a day's march, except that our men were by this time several miles down the river, and the day was practically lost. It seemed best to follow the trail as far as possible and see what the day would bring forth. After ascending steeply for one thousand feet, the trail enters a virgin forest on the almost level benches of the upper valley. Only a few rays of sunlight filtered through the silent trees. These dark evergreens of Canada are scarcely inhabited by squirrels or birds, but the utter quiet of deep woods was restful after the roar of the turbulent stream we had left below.

Photo by Wilcox

A Torrential Stream

At two o'clock we reached a point near the valley end 7,550 feet above sea-level, or nearly 3.000 feet above our camp in the Palliser. The fact that this valley runs south did not disturb our idea that it might be the Kananaskis Pass, as almost all the great passes make a series of right-angled turns through the lateral and transverse valleys of the several subranges. On Dawson's map, however, the Kananaskis Pass is given an altitude of only 6,200 feet, and as we were now 1,300 feet higher without reaching the summit, we suspected a serious error in his estimate or a mistake as to our own bearings.

In the evening our men reported that they went seven or eight miles down the river, where it became impossible to ford and the trail was obscure. No openings in the mountains that seemed possible passes appeared as far as they went. They said a wide valley comes in several miles below their turning point on the left side of the river, and that a large, muddy stream enters on the opposite side. The latter, no doubt, comes from the glaciers of a mountain over 11,000 feet high which we had seen many times northwest of our camp.

We made an early start next day, August 8, but lost much time crossing the strip of burnt timber between our camp and the canyon. While traversing this on foot I noticed that my clothes were smeared by a syrupy substance. Upon examination I found that this came from a kind of grass resembling wild barley, the stems and beards of which were covered by a thick, viscid liquid with a sweet taste. The plants so affected were inhabited by a minute brick-red insect no larger than a pinhead. They resembled a small spider, except for two antennæ curving first backward and then recurved forward at the ends. No doubt the bites of these parasites caused the thick syrup on the grass.

With two men ahead to cut out timber, we made rapid progress through the canyon. Our pack-train made an interesting picture winding along the foamy torrent, where a rough trail had been skillfully chosen by the Indians through a maze of obstacles which, at first sight, made it difficult to believe that a passageway could be found for men, to say nothing of pack animals. Immense masses of limestone, which had fallen from the canyon walls, and the trunks of trees, swept into the gorge in time of flood, made the trail wind and turn and even cross the stream. The loud roar of falling water made it impossible to talk or even hear the blows of the axe or the shouts of our men urging on the horses. The morning air was cold in the deep shade of the canyon and a damp mist swept against our faces from the endless cascades, while far above our heads the sun could be seen shining on the green forests of the upper valley. It required nearly five hours to reach some meadows in the middle part of the valley, where we camped in a delightful spot at 5,245 feet altitude. This point was half way to where we had walked the day before.

The scenery on every side of our camp was remarkable. On the north was a high ridge, covered far above timber-line by lawny patches of green grass, looking like velvet in the distance and making a striking contrast to the bare slides of red stone between them. To the east was an impressive mountain, rising from the meadow where our camp was located, and showing the entire sweep of the 4,000 or 5,000 feet to its bare and forbidding summit. Part of its highest peak, seen in profile, overhangs its base by at least 200 feet. This entire valley is covered with green forest, a pleasing change from the desolate Palliser River.

There was a little rain in the night, but the day broke fair and colder. The upper part of the valley was reached after a march of four hours. Above timber-line the trail was lost in open country and some time was wasted in an effort to locate it. Tom Lusk and I eventually found it in the middle one of three gulches which make passes into a valley to the south. From the summit we saw a vast extent of sharp peaks and strange mountains, with a green valley between, running due south. The pass is 7,600 feet high, and as the new valley runs so far south we gave up all hope that we were either on the Kananaskis Pass or likely to reach the lakes very soon. That we were temporarily lost in the heart of an unexplored wilderness only added to the interest of our movements and the appreciation of the wonderful scenery on every side. We could always, as our men said, "hit the back trail" or possibly find a more interesting route should a pass be discovered over the ranges between us and the Elk River. Camp was made in meadows below the pass at timber-line. In the afternoon

Photo by Wilcox

"We camped in a delightful spot"

Bryant and I climbed a mountain 8,400 feet high south of our camp. From this point a fine panorama was disclosed, and even Mt. Assiniboine could be seen far to the northwest beyond the Palliser River. A very high peak lies just north of the new pass, one that had been seen for two days, and that eventually proved quite a landmark in our travels. We were glad to see that the new valley running south was covered by green timber, a feature that adds very much to the interest of a country and to ease of travel. On the east side of this valley is a double range of mountains, the lower of which flanks the stream with abrupt precipices, while the higher makes a jagged line of sharp needles, now partly concealed by clouds, with their strata vertical. While we were on the summit a number of thunder-storms were sweeping over the mountains, and at length one came directly across our peak. We sought shelter from cold wind and hail among some crags just below the summit. When the storm was at its worst I noticed a curious sensation in my hair and mustache. Standing up I felt a tingling and heard a faint crackling sound. Bryant, who was quite near, said he observed nothing. However, we were almost on the summit of the mountain, and I have little doubt but that during the storm a large amount of electricity was passing between the clouds overhead and our peak, as there was frequent lightning and heavy thunder on every side.

Photo by Wilcox

"Lanes of green meadows and Alpine flowers"

The weather cleared in the evening and became colder. We were camped at tree-line, which in this part of the Rockies varies between 7,000 and 7,500 feet. Our camp was in open country intersected by long ridges of red stone,

Photo by Wilcox

"A long sweep of the river and a distant snow peak"

Photo by Wilcox

"Imposing precipices 3,000 or 4,000 feet above the valley" the latter being covered by a light growth of the beautiful larch, which resembles the eastern tamarack. Between these ridges were lanes of green meadows and Alpine flowers in their prime. The plumy heads of the great white anemone, which blooms near melting snow banks in early spring, were mingled with innumerable painted-cups, showing every possible shade of orange, yellow, crimson, and purple, and several species of yellow and purple composite flowers. Jim Wood came back from a trip into the other valley and reported the trail rather dim and apparently but little used.

It would be natural to inquire why trails exist in an unexplored wilderness. Though somewhat difficult to explain, the fact remains that almost every accessible valley in these mountains has some kind of narrow pathway running through them. Successful exploration depends in a large measure on finding and keeping to them, as they are certain guides out of precarious situations or impassable forests. No doubt the Indians, in their hunting and trading expeditions between the Kootenai River and the northwestern plains, made these trails long before the first approach of his white conqueror. Once made, they are used by wild animals, and are only obliterated by forest fires, snow-slides, or the caving in of river banks. I feel convinced that the most frequent cause of forest fires is carelessness on the part of white men; the next cause is lightning, and, last of all, the Indian, who is careful of his game preserves and his routes of travel.

The next morning, August 10, was so cold that ice formed half an inch thick in our water buckets. The day's march was very interesting. The ascent and crossing of the pass is easy, as the pitch is comparatively gentle on either side. The trail has been used by mountain goats and elk, the tracks of which were very abundant. Upon reaching timber on the other side we were shielded from the cold west wind, and in full glare of the sun the air grew rapidly warmer, and the frost and ice of early morning were replaced by dew sparkling on the grass. From one point we had a magnificent view of the new valley for at least 15 miles. We thought it was either the head of the mysterious Bull River or some tributary to the Elk. After an hour of descent we lost the trail in very thick woods on the top of a ridge, and were nearly forced to retrace our steps, as the fallen trees were of immense size and very much crossed. Natural decay and wind storms were the causes of this blockade, as no forest fire had ever apparently run through this region.

After a very trying search the trail was located in a ravine below. This valley, like most others in these mountains, has a very steep slope in its upper part, for we had descended 2,000 feet in the first three miles, and then a gradual descent where the valley opens out and becomes wider. By the union of small tributaries which the trail crossed several times the stream becomes quite large, and as the valley is nearly level there are many swampy places. After two hours of hard work finding a way through fallen timber and miry places, a gradual change took place for the better. At length the trail became clear and the traveling so easy that we had an opportunity to admire our surroundings. It would be difficult, indeed, to describe the beauty of this valley. The lower of the two ranges of mountains on the east side, which we had seen the previous day on our mountain climb, was now alone visible, and made an almost unbroken line of cliffs rising from 1,500 to 3,000 feet above us in vertical precipices. Above the narrow valley, covered with pines and spruce, this imposing wall of blue-gray limestone towered in supreme grandeur. Meanwhile the trail followed the river, which is here a broad stream with a winding course. Our long file of horses passed through a succession of glades where the forest trees came down to the river, alternating with fields of tall grass billowing in the breeze. In these meadows there were several old Indian camps, with their teepee poles standing ready for the next savage visitor. Each open place seemed to offer a new scene, some marvelous cliff reflected in a reedy pool or a long sweep of the river and a distant snow peak, while over all a typical [summer sky full of white clouds and sunshine gave a cheerful aspect to everything.

Camp was made in a charming spot after an estimated march of about eight miles. The afternoon was devoted to photography and fishing, but Bryant was unable to catch any trout in the fine stream before our camp, though it had every appearance of being full of fish. If this river is a tributary of the Elk, it should be full of fish, as the latter is a sportsman's paradise. However, the presence of waterfalls often causes an absence of fish in many

Photo by Wilcox

Climbing the Pass

streams and lakes where the conditions are favorable to them.

August 11 was partly cloudy in the early morning, but later the sky became perfectly clear. After two and one-half miles over a fine trail with a scarcely perceptible descent, we came to more Indian teepee poles and a division of the trail. The cliffs on the east rise into two sharp peaks facing the valley and make a kind of natural gateway into what appears a second and higher valley beyond. One of the two trails crosses the stream and seemed to head toward this opening, or rather behind it, while the other continues down the main valley, which is apparently very long and has a slight turn toward the west of south. After some discussion as to the better route, we decided not to lose this chance to work east. We had been forced by a continuous range many miles further south than we wanted to go, and it seemed advisable to locate ourselves as soon as possible before a spell of bad weather should make exploration difficult, if not altogether out of the question. Leaving the main valley at

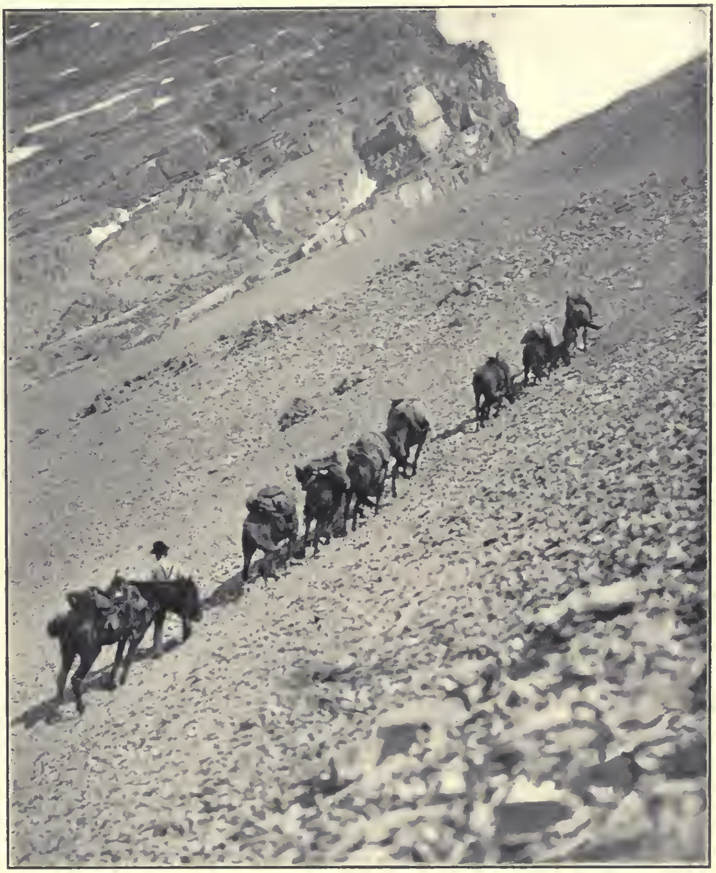


Photo by Wilcox

Approaching the Summit.

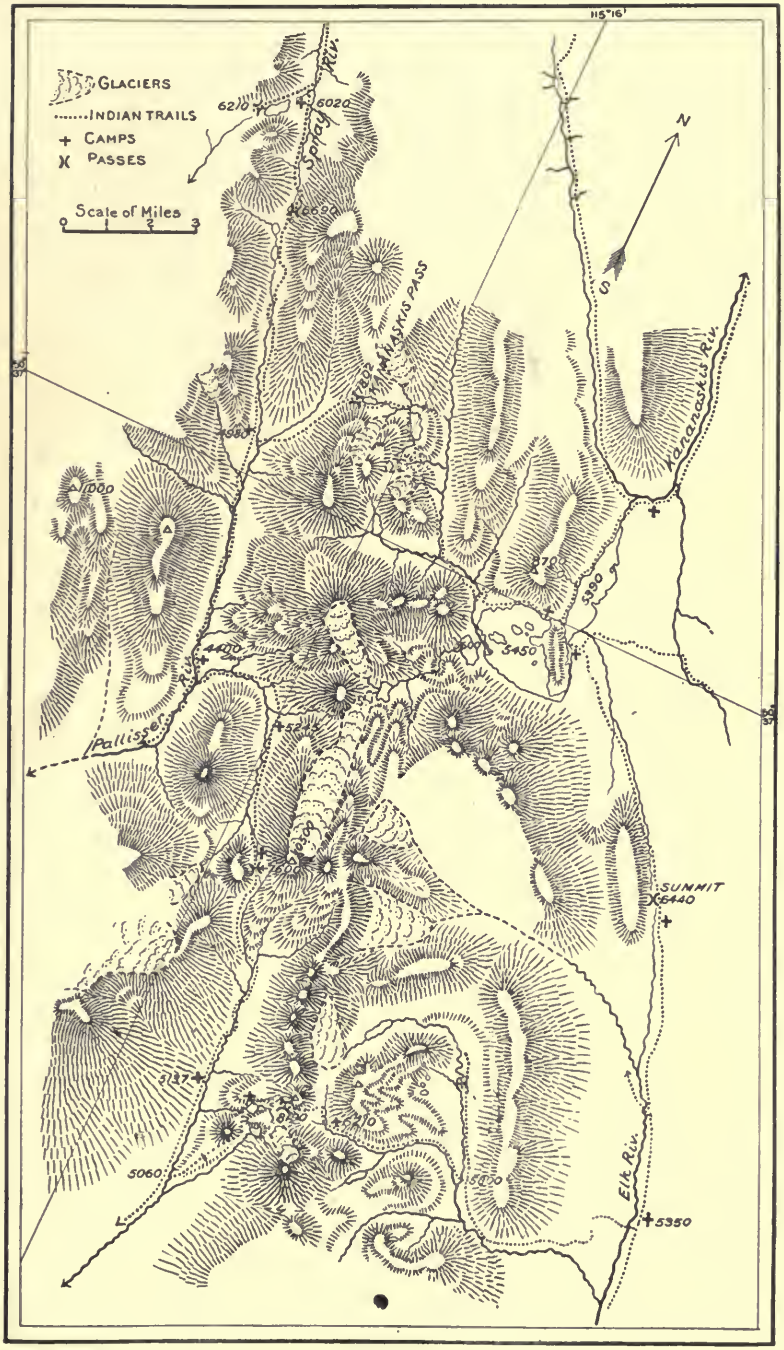
Photo by Wilcox

Resting on the Summit of the Pass

5,060 feet, the trail ascends sharply on the crest of a ridge running toward the natural gateway which had been seen from below. At 1,300 feet above the valley the scenery became very inspiring. A small lake now appeared below on our right, and after half a mile another glimpse of blue water was had over the pine trees. On the border of this we camped at 6,500 feet. Our tents were placed on a wooded point covered with deep, dry moss, projecting into the deep water of a charming tarn.

After lunch I set out with my camera to explore toward the east. My idea was to ascend a high ridge east of camp, from which I hoped to learn more about the country and possibly see the Kananaskis Lakes on the other side.

Shortly after leaving camp it was seen that a hoped-for pass, hitherto concealed, was blocked by a glacier. However, the trail led on and headed toward a ridge, which seemed from below a difficult scramble for a mountaineer. No other outlet appeared to right or left, and the trail was evidently too much used to lead only to some Indian camping place and stop there. Upon reaching a point 1,000 feet above the camp a magnificent view was disclosed. Our camp and the two round lakes nestling on the mountain side in the upper part of the forest belt lay below my feet. Beyond them, on the other side of the valley, stands a high mountain and a snow field several square miles in area. Ahead of me were the cliffs of two high mountains, on right and left, with sharp ridges and needles rising out of per-



Sketch Map of Region West and South of Kananaskis Lakes
by W. D. Wilcox

petual snow. The Indians in choosing a trail had most skillfully availed themselves of every little patch of soil and vegetation in a bare slope of limestone. On the upper parts, however, even these disappeared, and the trail was lined with sharp stones. A great deal of work had been done by throwing down the larger stones and paving a way with the smaller ones.

I approached the crest of the ridge at 8,140 feet with not a little excitement and interest. A short space of level ground makes the top of the pass, and then bends over into a valley of great depth. A large extent of new country was seen toward the east and south, with a green valley below and several ranges of mountains, all, however, of less height than those on either side of the pass, which were imposing precipices three or four thousand feet above the valley. How the Indians first got their horses over this place surpasses comprehension. Part of the trail was covered by snow even at this late date, and the slope was so steep that the stones were ready to slide. If a horse ever lost his balance here, it would be all over with him. After taking photographs, I made a difficult scramble to a spur half a mile distant to get a better view. Here I erected a cairn and took angles of all the prominent points. This otherwise barren peak was covered by forget-me-nots growing in the cracks of blue limestone, their stems short and stunted by cold. The beautiful clusters of bright flowers covered every slope and enlivened the bare rocks.

That night we had an excellent dinner, consisting, among other good things, of a grouse stew, the results of Tom's good hunting. Around the camp-fire we discussed the developments of the day, cheered by hotscotch, and now felt certain that the newly found valley would lead us into some tributary of the Elk River.

The next day, August 12, was warm and fair, with high fleecy clouds. The ascent and crossing of the pass by our fourteen horses was one of the most picturesque and interesting sights imaginable. The intelligent animals hardly knew what to make of the tremendous climb, and the sharp rocks cut their feet badly. We rolled down tons of stones, and repaired the trail as well as possible ahead of them. Both Bryant and I were busy also in getting snap shots of our pack-train from every point of view. A short rest and a precautionary tightening of cinches took place on the summit. Then ensued a still more difficult descent of 2,000 feet into the new valley. When we looked at the precipitous and snowbound pass from below, it seemed impossible that four-footed animals could traverse such a place. Nevertheless, thanks to the extraordinary care and skill of our packers, not one of the entire outfit of pack animals had a sore or chafed spot on his back, though most of them had been carrying from 150 to 200 pounds, jumping logs, and scrambling over steep passes every day for the past two weeks. The weather was very warm, and our tired animals had to fight swarms of bulldog flies and mosquitoes which appeared in this valley. The last two valleys had been almost free of them. Our men built smudges, around which the horses stood till late in the day, when a hard rain cooled the air, drove away the flies, and allowed our animals to feed in a meadow not far distant. Bryant walked about five miles down the valley in the afternoon to explore the trail, and said much less rain had fallen there than at our camp.

(To be concluded in the June number)

A GREAT AFRICAN LAKE*

By Sir Henry M. Stanley, M. P.

THE other day I was favored with a peep at Commander Whitehouse's map, and I was struck with the fullness of its detail and its accuracy. I took out my old note books, and then compared the rude sketches that I made as I went from camp to camp around the Victoria Nyanza twenty-seven years ago with the details which Commander Whitehouse has put in his map.

Mention has been made on more than one occasion of Ugowé Bay when speaking of this part of Africa. I remember when sailing from Bridge Island I came on a very spacious bay. Managing to get within about a hundred yards of the shore I saw a native and asked him what the name of the place was. I had to ask several times. Finally, in answer, I heard something which sounded like, "You go away." I said to myself, "Why, this must be a Swahili, who has fled from Zanzibar through committing some awful crime, and who has found shelter in this region." I again asked the man the name of the place, the man again replying, "You go away." Finally I got the interpreter to say that all I wanted was the name of the place, and again the answer was, "You go away." Under these circumstances I was, of course, bound to accept the name; anyhow, it would do very well as a landmark to indicate the place where the question had been asked, and it could be left to experts like Commander Whitehouse to come along some day and find out whether it was "U-jee-jee" or "You go away."

During his remarks Commander Whitehouse let slip a sentence which impressed me very much. He said, "The lake region is a very stormy one, and a day never passes without thunder, while a storm can always be seen somewhere, although it never lasts long. During the first survey of Port Florence, in 1898, there were no less than seventeen violent storms occurring within twenty-one days." On looking at the beautiful map shown by Commander Whitehouse I seemed to see the sailor, with his small crew and his little steel boat, wandering from point to point, crossing and recrossing, going from some island to some headland, taking his bearings from that headland back again to the island and to some point far away; then a tornado coming down, with a torrential downpour of rain, and perhaps a storm of hail, which threatened to fill the boat; then a few hours later a sun so fierce that the sides of the boat became so hot as to scorch the hand if they were touched. As I traced his many courses over the lake I thought to myself that Commander Whitehouse must have passed many anxious hours during the survey. He had said that he was occupied thirteen months in delineating the coast line of 2,200 miles in length.

When twenty-seven years ago I was instructed to go into that part of the world it was understood that I had to settle a question which very much vexed geographers at that time. According to Speke's theory that great lake, to which he had given the name "Victoria Nyanza," was one vast body of water almost equal to the size of Scotland in area, whereas, according to Sir Richard Burton, it was only a series of small lakes or swamps. The problem I had to settle was, which of the explorers was right. Hence I had to circumnavigate the lake. I carried a little sectional boat, built at

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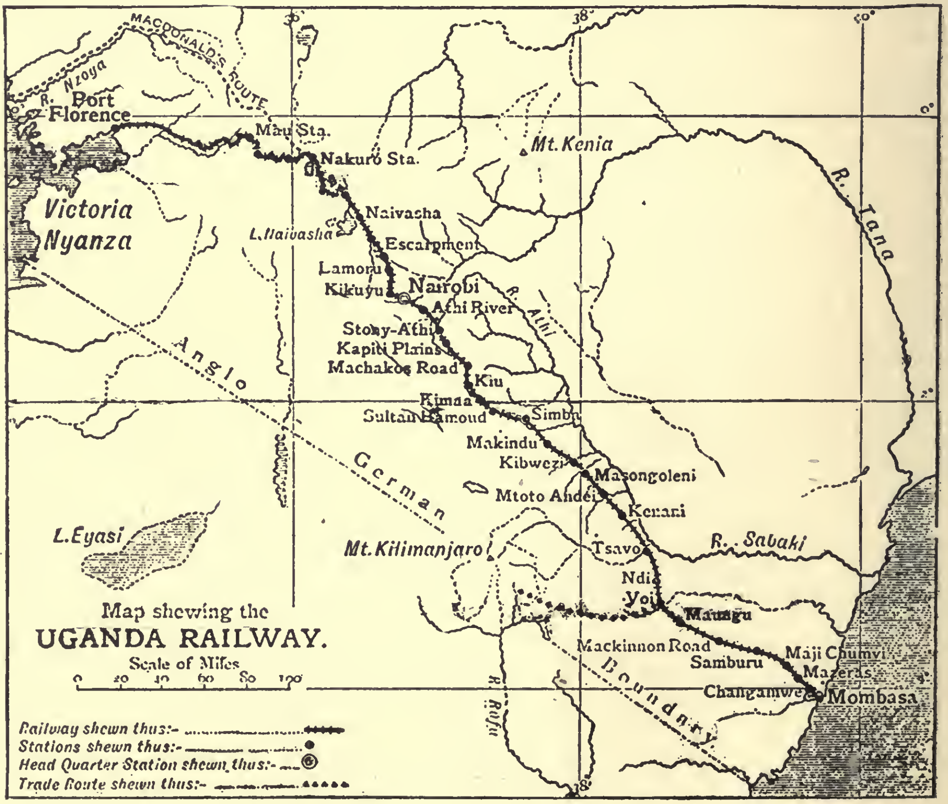
Teddington-on-Thames, and, after fifty-seven days' voyage with numerous adventures, I came back to the point from which I had started. Even had I had the time to examine more carefully the inlets, bays, creeks, and gulfs of the Lake Victoria, I could never have hoped to lay them down with the remarkable accuracy displayed by Commander Whitehouse. I remember that twenty-seven years ago after rounding the southern side and the eastern and northern coasts of the lake, and coming half way down, just south of the equator, we were driven from the mainland by some cantankerous natives, and came to a small islet where at last we were perfectly safe from all harm and had leisure to reflect. Ascending to the highest peak of that little islet, I saw a boundless extent of fresh-water sea toward the north, east, and south, while toward the west and southwest there was a magnificent extent of hitherto-unexplored territory. I could not help but admire the scene, and I seemed to see as in a vision what would happen in the days to come. I seemed to see steamers trailing their dark smoke over the gray waters of the bay, loaded with passengers and natives about to exchange and barter at some well-established port, and the natives of Uganda, instead of looking with contempt upon the wild, savage Usukuma at the south, willingly coming down to exchange their coffees for the cattle of Usukuma, and shaking hands in all friendship with the natives of the east coast making blood-brotherhood with the natives of



the west coast; I seemed to hear church bells ringing at a great distance away, and I hoped and prayed that some day that vision might be realized.

Twenty-seven years have passed, and I think it will be admitted that we are on the eve of the realization of that vision. In those days Mtesa, of Uganda, impaled his victims and clubbed his women to death upon the slightest provocation; the slingers of the islands stood ready to welcome the wayfarer or the traveler with showers of stones, and along all the shores described by Commander Whitehouse there was a group here and there, or an army at another place doing all the tricks common to barbarous people, and sighing and thirsting for blood. Those days have passed by. The missionaries have been laboring since 1877 in Uganda, and as the result of their labors can show 90,000 Christian people. Three hundred and twenty churches have been established there, and there are many thousands of children at school. It was only the other day I received a letter from a man at Mengo saying there were 500 children in the Mengo school every day. The converts of Uganda are now actually carrying the gospel to the distant lands of the west. Toro has been made acquainted with the gospel. Usongora, which was a wild and devastated country only twelve years ago, now welcomes the white traders; at Kavalli, where I rested some months, the people are beginning to take a strong interest in the white man's religion.

Such has been the change wrought in twenty-seven years. Though it has been slow work; though missionaries have often felt depressed, broken-hearted, and dispirited, suffered persecution and been expelled from Uganda; though the native converts have suffered torture and death, still the missionaries have persevered, and in the end they have received their reward. They now know that the terminus of the great railway is built on the very shore of the lake, while one steamer, the *William Mackinnon*, is daily trafficking between Port Florence, on the east, and Entebbe, on the northwest. She is but the precursor of a fleet of such steamers.

In 1880, 1881, and 1882 I carried three small steamers on to the Upper Congo; today there are eighty, with a tonnage of about 10,000 tons. Today there is only one steamer of seventy-five feet in length on the Victoria Nyanza; in ten years hence there will very likely be fifty, in twelve years one hundred, in fifty years two hundred, and that is the way civilization will go on spreading out and stirring the dark peoples to activity.

There are two main motives for which the British nation voted the money for the construction of the Uganda Railway. The first is the suppression of the slave trade, and the second was to effect an uninterrupted and speedy communication between the sea and what is called the "Pearl of Africa," and today those two objects have been accomplished. The slave-trader cannot now be found in those regions, otherwise the very sight of a white man would be fatal to him, while as for the uninterrupted and speedy communication, it only now requires two and a half days to reach Uganda from the sea, whereas it previously occupied months. Speke took nine months to reach Uganda; it took me eight; but two or three years ago it took the missionaries generally six months. One brave and energetic traveler takes three months. Now it can be done in two and a half days.

If the lake region has advanced so marvelously as it has done during the slow period, when the laden porters carried the loads of the missionary, the sugar chest of the trader, and the weights of the steamer up to Uganda, what will be its rate of progress now that Uganda is brought within two and a half days of the sea? While congratulating ourselves on what has been accomplished during the last twenty-seven years, we should remember gratefully the services of the missionaries, and also of those wise men who, like Sir Gerard Portal, emphasized over and over again to the government the need of the Great Uganda Railway to redeem the land. We must also recollect the sagacious administrators who have been sent to Uganda, who, by their tolerance and tact, have taught the natives wherever they go that the advent of the Englishman was a blessing to them.

COAL RESOURCES OF ALASKA

ALASKA embraces about 600,000 square miles and stretches through nearly 20 degrees of latitude and 50 degrees of longitude. Practically no detailed investigations of any part of this vast territory have been made, and at least a third part of its area has not even received preliminary topographic and geologic surveys. Our knowledge of its mineral resources is therefore very incomplete.

What is known of its coal resources has been compiled and is presented by Mr. Alfred H. Brooks in Part III of the Twenty-second Annual Report of the United States Geological Survey. This compilation is not from printed sources alone, but is largely from manuscript notes made on the spot by Mr. Brooks himself and by others. Mr. Brooks divides Alaska, for purposes of his report, as follows: Beginning on the south, southeastern Alaska includes the Pacific Ocean coastal belt and islands, extending northward to Mount St. Elias and northwestward so as to include the Copper River Basin. Beginning on the west, southwestern Alaska embraces the Aleutian Islands, Alaska Peninsula and adjacent islands, Kenai Peninsula, and the Cook Inlet region, with the drainage basins of its tributary rivers. The Kuskokwim region lies west of Bristol Bay and Cook Inlet and east and south of the Yukon, and drains into southeastern Bering Sea chiefly through the Kuskokwim River. The eastern part of this region is broken by the Alaskan Range of mountains. To the west of these mountains is the broad basin of the Kuskokwim River. A small southern part of this region drains directly into Bering Sea by a number of short rivers.

The Yukon Basin includes a great area lying partly in Alaska and partly in British Northwest Territory and British Columbia. The chief tributaries of the Yukon are Koyukuk, Tanana, Porcupine, White, Pelly, and Lewes rivers, the two last uniting to form the Yukon proper, and their drainage basins are wholly within Canadian territory. The larger part of the basin is occupied by the great Yukon Plateau, sloping from about 5,000 feet near the headwaters above sea-level to 2,500 feet at the great bend of the river. East of this plateau lies the northern extension of the Rocky Mountains, which near the Arctic Coast turns abruptly west, parallel to the coast, forming the Romanzof, Davidson, and De Long mountains, the Arctic-Yukon watershed. On the southwest side of the Yukon Basin the Coast Range and the St. Elias Range and the Alaskan ranges form the barrier and in part the watershed of the basin. Northwestern Alaska includes an ill-defined area northwest of the Yukon Basin. Seward Peninsula, cut off from the mainland by Norton Sound on the south and Kotzebue Sound on the north, is an important feature of this province. Several rivers drain from this area into Bering Sea and the Arctic Ocean.

Northeastern Alaska has been but little explored. It includes the drainage basins of rivers between Point Barrow and the international boundary. The geology and mineral resources of this region are unknown. The occurrence of coal in Alaska, as in the western United States, is limited to the rocks of the later geologic periods (the Mesozoic and Tertiary). The rocks of these ages have an extensive distribution in the territory, and at a number of widely separated localities workable coal beds have been found.

In 1852 the Russian-American Company prepared to open coal mines at Port Graham, on the western side of Kenai Peninsula, but soon abandoned their operations, though an American company mined coal at Port Chatham and supplied the Russian company's steamers for about ten years longer. In 1868 a few tons of coal were mined at Kootznahoo Inlet, Admiralty Island, for the United States Steamship *Saginaw*, and in 1868 coal was reported near Point Gardiner, Admiralty Island. Considerable prospecting has been done at Killisnoo, Admiralty Island, and the Firestone mine has been worked for local use since 1880. The Admiralty Coal and Fuel Company did considerable development work in 1900 at Point Gardiner.

In 1872 coal was mined at Coal Bay, Unga Island, for the United States Steamship *Humboldt*, and the mining of these southern Alaska coals has gone on in a small way for a number of years. In 1888 the Alaska Coal Company began mining at Kachemak Bay, west of Kenai Peninsula, and since 1899 the Cook Inlet Coal Fields Company seems to have controlled this field, and are now operating extensively. Since 1893 the Alaska Packers' Association has been mining intermittently at Chignik River, southeastern Alaska Peninsula. In 1889 the development of coal mines at Herendeen Bay, western Alaska Peninsula, was begun, but without great success.

The coals of the Yukon River attracted little attention until the discovery of gold in the Klondike region, in 1897. Within a year there were probably upward of a hundred steamers on the Yukon River, with wood selling at from $8 to $20 a cord, and with no wood to buy on the lower Yukon below the Holy Cross Mission. Soon some of the larger companies established a coaling station at St. Michael for the use of river steamers, but with the resultant disadvantage that the steamer must take most coal when she has most freight. Much investigation of the coal supply of the Yukon River has taken place. In addition to coal mines in British Northwest Territory, the Alaska Exploration Company started some developments about 60 miles above Circle City, on the upper Yukon. The oldest mine is Drew's, opposite the mouth of Hess Creek, where the workings are extensive, and the equipment includes steam hoisting apparatus, coal bunkers, etc. The Pioneer mine, below Hess Creek and 30 miles above Rampart, is similarly equipped. Both mines produced considerable coal in 1900. Near Nulato, farther down the Yukon, the Blatchford and the Pickart mines produced some coal, and the Clemens Thein mine and the Williams mine, both between Nulato and Anvik, were small producers in 1900. As a result of the development of the Cape Nome gold fields, the Cape Lisburne coal deposits, in northwestern Alaska, have attracted renewed attention, and the Corwin Trading Company is now engaged in endeavoring to develop these deposits to supply Nome and the whaling ships, which have heretofore brought their coal from Puget Sound.

The coals are chiefly lignites, with some bituminous coals, and in a few localities semi-anthracites. Developments so far have been entirely along waterways.

The southeastern and southwestern Alaska coal fields are on tide water along a coast affording good harbors open to navigation the entire year. They can be mined cheaply and can find a ready market for local steamboat and domestic use. No developments have been made of the higher-grade coals of southern Alaska. These higher-grade coals are worthy of the attention of prospector and capitalist, for, if found to occur in sufficient quantities, they could compete with all other coals in the Pacific Coast market.

The Yukon coals as developed depend entirely on their local market. Their grade is too low for exportation; but the Yukon coals seem to vary greatly in character, and careful preliminary work should be done before a mine is developed. The Yukon coals are said to bring about $15 a ton at the mines. Nome has offered a splendid market for coal during the last two years. Coal sold there at from $25 to $100 per ton, with an average price of about $40 to $50 per ton during the summer of 1900. It was this that led to the development of the Cape Lisburne field, where the coals are of a semi-bituminous character, which is only 200 miles distant.

In 1900 about 13,000 tons of coal were shipped as cargo to Alaska from Washington ports, and probably still more was imported from British Columbia. No accurate data as to the coal produced by Alaskan mines are obtainable, but the total is probably between 4,000 and 5,000 tons, of which about a third is from mines on the Yukon River.

THE HUBBARD MEMORIAL BUILDING

THE cornerstone was laid on April 26 of the Hubbard Memorial Building, which will be the home of the National Geographic Society. The building occupies a large and handsome site on the southwest corner of Sixteenth and M Streets, Washington, D. C., and when completed will be a notable monument to the honored first President of the Society.

The contents of the box deposited in the cornerstone were as follows:

1. An engrossed document relating to the *Hubbard Memorial Building*, and also to the *Hubbard Memorial Window* in the Church of the Covenant, Washington, D. C., both dedicated to the memory of the late Hon. Gardiner Greene Hubbard. This document is signed by Mrs. Hubbard and by all the surviving descendants. The following is a copy of it:

HUBBARD MEMORIAL BUILDING

This building is erected in memory of GARDINER GREENE HUBBARD by his children, Gertrude, Mabel, Roberta, and Grace. Gertrude, being no longer living, is represented by her only child, Gertrude, daughter of the late Maurice Neville Grossmann, and Roberta, being no longer living, is represented by her surviving children, Helen and Grace, daughters of Charles James Bell.

The library is the gift of Mrs. Gardiner Greene Hubbard, who joins her children in establishing this memorial to her husband.

The building is designed to be the home and headquarters of the National Geographic Society, of which Mr. Hubbard was President from the date of its organization, January 20, 1888, to the day of his death, December 11, 1897.

Another monument to Mr. Hubbard exists in the Church of the Covenant, Washington, D. C., in the form of a *Memorial Window* presented by Mrs. Hubbard, which portrays in allegory the leading characteristics of Mr. Hubbard's life and its tranquil close in the midst of his useful and abounding work.

The memorial window may be identified from the following published description:

> "A stately figure stands with uplifted face, looking toward the western sky; the glory of the sunset is above and about him; fields of green and yellow spread around him; sheaves of golden grain are heaped beside him; from his hand the seed still drops into the open furrow, the soft shadows fall, and the evening star rises."

The box containing this document and other papers and coins will now be sealed and deposited in the cornerstone of the Hubbard Memorial Building in the presence of Mrs. Gardiner Greene Hubbard, and all the surviving descendants of Mr. Hubbard, together with a few personal friends.

The cornerstone will be laid by Melville Bell Grosvenor, the infant great-grandson of Gardiner Greene Hubbard, in the arms of Mrs. Hubbard.

Witness our signatures this 26th day of April, 1902.

GERTRUDE M. HUBBARD (MRS GARDINER GREENE HUBBARD)

CHILDREN

MABEL GARDINER BELL AND HER HUSBAND, ALEXANDER GRAHAM BELL
GRACE HUBBARD BELL AND HER HUSBAND, CHARLES J. BELL

GRANDCHILDREN

GERTRUDE HUBBARD GROSSMANN
ELSIE MAY BELL GROSVENOR AND HER HUSBAND, GILBERT H. GROSVENOR
MARIAN H. GRAHAM BELL
HELEN A. BELL
GRACE HUBBARD BELL
GARDINER HUBBARD BELL
BOBBY BELL

GREAT-GRANDCHILD

MELVILLE BELL GROSVENOR (×) HIS MARK

2. A copy of the NATIONAL GEOGRAPHIC MAGAZINE issued February, 1898, vol. ix, No. 2, containing:

A portrait and signature of the Hon. Gardiner Greene Hubbard.

Address of Rev. Dr. Hamlin delivered at the memorial services held at the Church of the Covenant, December 13, 1897.

Proceedings of the memorial meeting of the National Geographic Society held January 21, 1898.

Introductory remarks by the President, Alexander Graham Bell.

Address of Dr. George N. Sternberg, Surgeon General, U. S. A., on behalf of the Joint Commission of the Scientific Societies of Washington, D. C.

Addresses of Prof. S. P. Langley and the Hon. William L. Wilson, on behalf of the Smithsonian Institution.

Address of Miss Caroline A. Yale, principal of the Clarke School for the Deaf, on behalf of the American Association to Promote the Teaching of Speech to the Deaf.

Address of Dr. B. L. Whitman, President of Columbian University, on behalf of the University.

Address of Dr. Marcus Benjamin, on behalf of the Society of Colonial Wars.

Address of Dr. Daniel C. Gilman, President of Johns Hopkins University, on "Gardiner Greene Hubbard as a Helper."

Address of Major John W. Powell, on behalf of the journal *Science*.

Address of the Hon. A. R. Spofford, on behalf of the Columbia Historical Society.

Address of the Hon. John W. Ross, Chairman of the Board of Commissioners of the District of Columbia, on behalf of the city of Washington and the District of Columbia.

Address of General A. W. Greely, on behalf of the National Geographic Society.

3. A copy of the *Association Review*, an educational magazine published by the American Association to Promote the Teaching of Speech to the Deaf, October, 1899, vol. 1, No. 1, containing:

A portrait and signature of Gardiner Greene Hubbard, and

An account of the life of Gardiner Greene Hubbard by his wife, Gertrude M. Hubbard.

4. A book entitled "The Story of the Rise of the Oral Method in America, as told in the writings of the late

Hon. Gardiner G. Hubbard," published Washington, D. C., 1898, containing:

A portrait and signature of the Hon. Gardiner Greene Hubbard.

An introduction by his daughter, Mabel Gardiner Bell (Mrs. Alexander Graham Bell).

Extracts from the writings of the Hon. Gardiner Greene Hubbard relating to the education of the deaf, compiled and arranged by his daughter, Mabel Gardiner Bell.

5. A copy of the *Association Review*, dated February, 1900, vol. II, No. 1, containing the opening chapters of a work entitled "Historical Notes Concerning the Teaching of Speech to the Deaf," published as a tribute to Mr. Hubbard's labors on behalf of the deaf, written by his son-in-law, Alexander Graham Bell.

6. A composition on the life of Gardiner Greene Hubbard, written by the pupils of the Gardiner Greene Hubbard School, Washington, D. C., eighth grade—Horton Simpson, principal, April 17, 1902.

7. A pamphlet entitled "The Education of Deaf-Mutes: Shall it be by signs or articulation?" by Gardiner Greene Hubbard, published Boston, Mass., 1867; contributed by the Hon. John Hitz, superintendent of the Volta Bureau for the Increase and Diffusion of Knowledge Relating to the Deaf, Washington, D. C.

8. A pamphlet entitled "Further Contributions to the Study of that Subtile Art which may Inable one with an observant eie to heare what any man speaks by the moving of the lips (Bulwer, 1648)," by Mrs. Alexander Graham Bell; extracted from the Proceedings of the Fourth Summer Meeting of the American Association to Promote the Teaching of Speech to the Deaf, July, 1894.

9. A poem by Major John W. Powell, entitled "*Becoming*," dedicated to Mrs. Gardiner Greene Hubbard.

10. Specimens of United States coins.

11. Miscellaneous.

GEOGRAPHIC NOTES

FORECASTING THE WEATHER

IN a recent address, published in the *Marine Review*, Prof. Willis L. Moore, Chief of the Weather Bureau, emphasized the point that any person, by studying the few simple principles on which the daily weather map is founded, can estimate the general character of the weather for his region one, two, or, at times, three days in advance.

"By preserving the weather charts each day and noting the movements of the highs and the lows, any intelligent person can make a fairly accurate forecast for himself, always remembering that the lows, as they drift toward him from the west, will bring warmer weather and sometimes rain or snow, and that, as they pass his place of observation, the highs following in the tracks of the lows will bring cooler and probably fair weather.

"He can closely forecast the temperature for his region by remembering that the weather will be cool so long as the center of the predominating high, *i. e.*, the high enclosing the greatest area within the 30-inch isobar, is north of his latitude—either northeast or northwest—and that it will be warm so long as the high is south of his latitude. . . .

"To get a rough idea of the difference between storms, we might classify them, according to the diameter of the gyrating masses of air under their influence, as follows:

"Cyclones, 1,000 to 2,000 miles; hurricanes, 100 to 500 miles, and tornadoes, 100 to 1,000 feet. We might imagine their vortical action and their destructive force to increase in some ratio as their diameters of rotation decrease.

"The tornado is always an incident and a sporadic outbreak of the cyclone, and usually occurs in the southeast quadrant of a cyclonic storm.

"The thunder-storm, instead of rotating about a vertical axis, like the cyclone and tornado, has a horizontal roll, caused by cold and heavy air from above breaking through into a lighter and superheated stratum next to the earth. This rolling motion throws forward the cool air in the direction in which the cloud is moving. In general, thunder-storms move from the west toward some eastern point, the same as tornadoes, which mostly move from the southwest toward the northeast. If any part of the horizontally rolling air in the thunder-storm drops down toward the earth and adjusts its rotation about a vertical axis it at once becomes a tornado, and its destructive force is increaed a hundredfold."

NO NEWS OF ANDRÉE

THE recently revived reports that portions of the balloon in which Andrée attempted to reach the North Pole had been found in northern Canada have been discredited by the commissioner of the Hudson Bay Company in a letter to Mr. William Ziegler, of New York. The commissioner writes in part as follows:

"It is a matter of great regret to me that I cannot bring myself to offer encouragement to any hopes which friends of the explorer may have of his still surviving anywhere in northern Canada. In the few portions of the Far North where the company's people do not come in touch with the natives, whaling vessels from American and British ports traffic with the natives.

"There is no probability of there being any truth in the report regarding the supposed finding of Andrée's balloon. The chief officer of the company on the west coast of Hudsons Bay, who himself interviewed the natives on the matter, has reported as his firm conviction that the natives who are said to have seen the balloon imposed upon the clerk at Churchill, to whom the story was given. The sketches of the balloon which the company has been careful to distribute throughout northern Canada naturally gave occasion for much talk among these isolated people, and it is not greatly to be wondered at that some such tale might be given out by natives peculiarly cunning and prone to practice upon the credulity of those not familiar with them or easily imposed upon."

COMMANDER BORCHGREVINK

C. E. BORCHGREVINK, the Antarctic explorer, who has gone farther south than any man, has made formal application to become an American citizen. On April 25 he filed his first papers at Washington.

The American Robert E. Peary holds the record for having reached the most northerly land, so that the United States may now claim as citizens the two men who have reached the most remote land at each end of the globe. Lockwood and Brainard, of the Greely expedition, had for 18 years, from 1882 to 1900, held the record of the most northerly land, 83° 25′, which Peary surpassed by 15′ in the spring of 1900, when he reached 83° 39′. The Italian Duke of Abruzzi has been farthest north on the open sea, 86° 33′.

Carsten Egeberg Borchgrevink (the ch is pronounced hard, like k) was born at Christiania in 1864. His training and taste made him a sailor scientist. Early in the nineties he led one expedition to the far south, in which he did some notable work, but the expedition was especially valuable, in that it gave him good experience in South Polar work. His great achievement, however, was in his last expedition of 1898–1900, when his party was the first in history to pass the winter camped on the Antarctic Continent. He penetrated farther south than any man had ever done before, and also made some important biological discoveries. Among his collections he brought back a jelly-fish weighing no less than 90 pounds.

Mr. Borchgrevink's plans are yet too indefinite to announce. He will for some years yet be a rover, but the United States will be his home.

On April 12 President Alexander Graham Bell gave a dinner in Washington in honor of Commander C. E. Borchgrevink. Vice-President W J McGee, as the toastmaster of the evening, introduced the following toasts:

"The President of the United States," Justice Harlan; "His Majesty King Oscar," Mr. Hauge, Secretary of the Swedish and Norwegian Legation; "The Navies of the World," Admiral Dewey; "Our Nation and Others," Senator O. H. Platt, of Connecticut; "The Explorers of the Ends of the Earth," Rear Admiral Melville, General Greely, Mr. Walter Wellman, Commander Borchgrevink; "The National Geographic Society," President Graham Bell.

Those present were: President Alexander Graham Bell, Commander C. E. Borchgrevink, General Greely, Mr. F. V. Coville, Mr. S. H. Kauffmann, Mr. Henry Gannett, Mr. Walter Wellman, Hon. David J. Hill, Admiral Dewey, Dr. W J McGee, Justice Harlan, Admiral Melville, Mr. C. J. Bell, Mr. O. H. Tittmann, Mr. Arthur W. McCurdy, Col. Henry F. Blount, Prof. A. J. Henry, Mr. Marcus Baker, Mr. Angelo Heilprin, Mr. George Kennan, Prof. Willis L. Moore, Representative E. J. Hill, of Connecticut; Mr. Hauge, Senator O. H. Platt, of Connecticut; Mr. George Eastman, President Eastman Kodak Company; Dr. C. Hart Merriam, Mr. Gifford Pinchot, and Mr. Gilbert H. Grosvenor.

DECISIONS OF THE U. S. BOARD ON GEOGRAPHIC NAMES.

January to April (inclusive) 1902

ALL decisions rendered by the Board from its creation down to April, 1900, were published in its second report, March, 1901. For decisions rendered during the remainder of 1900 and in 1901, see NATIONAL GEOGRAPHIC MAGAZINE, vol. xi, pp. 329, 478; vol. xii, pp. 87, 125, 200, 242; vol. xiii, p. 28.

Aektok; island, near west end of Avatanak Island, Krenitzin group, eastern Aleutians, Alaska (not Aiaktak, Goloi, Goly, Ouektock, nor Rootok).

Agamgik; bay, indenting the northern shore of Beaver Bay, Unalaska Island, eastern Aleutians, Alaska (not Food).

Battery; point, the eastern head of Sarana Bay, on south shore of Akutan Island, eastern Aleutians, Alaska (not Kaianak, Liberty Cap, nor South Head).

Bosporus; strait between Black Sea and Sea of Marmora, Europe. (This is a reversal of the decision Bosphorus, rendered by the Board January 12, 1897)

Chiwawa; creek, Chehalis County, Washington (not Chiwahwah).

Curlew; creek, lake, and post-office, Ferry County, Washington (not Karamin nor Karamip).

Forest; lake, in Woodbury, Orange County, New York (not Slaughter's Pond).

Goosmus; creek, Ferry county, Washington (not Goos nor Koosmus).

Howes; cave in Cobleskill, Schoharie County, New York (not Otsgaragee).

Howes Cave; post-office, Schoharie County, New York (not Howecave, Howe Cave, Hows Cave, nor Howe's Cave).

Iliuliuk; the chief town of Unalaska, eastern Aleutians, Alaska (not Unalaska).

Kisselen; bay, at the head of Beaver Bay, Unalaska, eastern Aleutians, Alaska (not Kissialiak, Warsham, nor Worsham).

Levashef; port or harbor at head of Unalaska Bay, Unalaska, eastern Aleutians, Alaska (not Captains nor St. Paul).

Marcy; mountain peak, the highest point in the Adirondacks, Essex County, New York (not Tahawus).

Mechanicville; post-office and village, Saratoga County, New York (not Mechanicsville). (This is a reversal of the decision Mechanicsville, rendered by the Board April 4, 1900.)

Rabbit; creek, Ferry County, Washington (not Nine Mile).

Samganuda; bay indenting the eastern shore of Unalaska, eastern Aleutians, Alaska (not English).

Sanpoil; lake and river, Ferry County, Washington (not Rowena nor San Poil).

Sigak; cape, the north point of Akutan Island, eastern Aleutians, Alaska (not North Head).

St. Helens; mountain, in Skamania County, Washington (not St. Helen).

St. Peter; creek and flat, Ferry County, Washington (not Rock).

St. Vrain; creek and precinct, Weld County, Colorado (not St. Vrains).

Tanaskan; bay, indenting the southern shore of Beaver Bay, Unalaska, eastern Aleutians, Alaska (not Macks nor Taneska).

Tangik; islet, near the eastern shore of Akun Island, Krenitzin group, eastern Aleutians, Alaska (not Waverly).

Tanginak; islet, east of Akun Island, in Unimak Pass, Alaska (not Breed nor Propagation).

Teroda; creek and mountain, in Ferry and Okanogan Counties, Washington (not Tarrota nor Toroda).

Ugalgan; island, near the easternmost point of Unalaska, eastern Aleutians, Alaska (not Egg, Gagalgin, Iachnoi, Jaitschoi, Kigalgin, nor Orieshik).

Unalaska; bay, indenting the northeastern shore of Unalaska Island, eastern Aleutians, Alaska (not Captains).

Urilia; bay, on the northern coast of Unimak, eastern Aleutians, Alaska (not Shag nor Shaw).

Usof, bay, indenting the southeastern shore of Unalaska, eastern Aleutians, Alaska (not Whalebone).

Wallkill; river, in Ulster and Orange Counties, New York (not Wall Kill).

Witchcoat; point, Back River, Baltimore County, Maryland (not Witchcoate).

THE LATEST MAP OF SOUTHERN CALIFORNIA

THE United States Geological Survey has just issued the first of a series of three map sheets which will cover the region in California extending from San Diego to Santa Barbara, including the adjacent mountain ranges, and will form a map of the whole southern portion of the state.

Sheet No. 1, which has lately been issued, is compiled from 23 atlas sheets of the U. S. Geological Survey. It comprises within its limits the San Gabriel Timber-land Reserve, the San Bernardino Forest Reserve, the Trabuco Canyon Forest Reserve, and parts of the San Jacinto, Pine Mountain, and Zaca Lake Forest Reserves. It contains all of Orange County, the greater part of Los Angeles County, and portions of Riverside and San Bernardino counties. It includes all of what may be termed the Great Valley of Southern California, extending from Los Angeles to the vicinity of San Bernardino, as well as the mountains which are the source of the waters that irrigate its orchards and farms. These map sheets, which are listed by the Geological Survey at 10 cents each, are 21 by 33 inches and are drawn on a scale of about four miles to the inch. The relief of the country is shown by contour lines.

EXPEDITIONS IN THE ARCTIC AND ANTARCTIC

LIEUT. ROBERT E. PEARY is now leading his last campaign to gain the North Pole. He probably started from Cape Hecla some weeks ago, and is now well on his way north. The Peary auxiliary steamer, under command of Mr. H. L. Bridgman, will leave Sidney, N. S., about the middle of June to carry supplies to Peary and to bring him home.

The Baldwin auxiliary expedition will sail from Tromsö, Norway, on July 1. The expedition will be in charge of W. S. Champ, secretary to William Ziegler, who is Mr. Baldwin's financial backer.

No news has now been had of Sverdrup since 1899. It is generally believed he is among the Parry Islands. Considerable anxiety is felt in Sweden and Norway for his safety, and a relief expedition is planned to set out in a few weeks.

It has been cabled from Europe that Baron Toll, who has been seeking to repeat Nordenskiold's voyage around the entire north coast of Asia, has given up his original plan and is now returning to St. Petersburg. His vessel passed the winter among the New Siberia Islands. There was not coal enough to continue the voyage eastward, and to transport coal to the New Siberia Islands would have cost so much that the original plan was abandoned. It is stated that Baron Toll is proceeding up the Lena River, and will meet the Trans-Siberian Railway at Irkutsk.

In the South Polar regions the German expedition on the ship *Gauss* sailed from the Kerguelen Islands in the latter part of January of this year, bound for Termination Land. The party were in good spirits, and everything ready for a successful winter.

The English expedition, after considerable difficulty with their vessel, the *Discovery*, because of its leaking, sailed from New Zealand early in 1902, bound for Victoria Land. A relief expedition is now being prepared in England. King Edward has subscribed $500 toward the expenses of the party.

The Swedish South Polar Expedition reached Cape Horn too late in the season to proceed very far south. The expedition will remain among the New Falkland Islands during the present southern winter, and then proceed south toward the end of 1902.

Dr Emil Holub, the well-known explorer of interior Africa, died on February 21, 1902. As a young man Dr Holub read the journeys of David Livingstone and became greatly interested in the problems of natural life on the great continent. After studying medicine and natural science at Prague he went to South Africa in 1872, as a doctor to the diamond fields. During the next few years he made several journeys into the interior, in 1875 reaching the Zambezi and Victoria Falls and always making large collections. On his return to Europe in 1879 he distributed his many collections to 113 Austrian and foreign museums and schools. Several years later he again went to Africa with the purpose of proceeding from Cape Town straight across the continent to Cairo. The troubles in the Sudan, however, made this plan impossible and confined his work to southern Africa. In 1887 he returned to Europe with 13,000 objects, which he again distributed to schools and museums. He published many books and lectures—"Sieben Jahre in Südoffike," "Die Kolonisation Afrikas," "Von Kapstact in's Land der Mashukulumbe," etc., etc.

Photographic films may now be developed in a small apparatus or box about the size of a camera without recourse to a dark room and by a process wonderful in its simplicity. This new and important addition to photography is the result of several years of careful experiment and research by Mr. Arthur W. McCurdy, of Washington, D. C.

The first automobile to cross the great mountain range of the Caucasus, by way of the Georgian Military Road and the Dariel Pass, has recently carried from Vladikavkaz to Tiflis the present Minister of Ways and Communications, Prince Hilkof. The behavior of the automobile, says the Russian *Terek Messenger*, was in every way satisfactory, and even on steep descents, with sharp curves, where travel with horses is sufficiently terrifying, the vehicle maintained a speed of twelve miles an hour, without the least jerking or jolting. "This achievement," the *Messenger* says, "proves that automobiles may be used, not only on the great Caucasian road" (which goes to a height of more than 8,000 feet), "but upon Russian roads of all sorts."

Dr. C. Willard Hayes has been appointed "geologist in charge of geology" in the U. S. Geological Survey. The duties of the office make Dr. Hayes the administrative head of the geologic work of the Survey, leaving the more immediate scientific direction to the chiefs of the different divisions in geology.

NATIONAL GEOGRAPHIC SOCIETY

MEETINGS OF THE SOCIETY:

March 21, 1902.—President Graham Bell in the chair. Mr. Robert Dunn, of New York, gave an address describing his explorations of the Wrangell group of mountains in Alaska in 1900.

Lieut. H. T. Allen, 2d U. S. Infantry, the first explorer of the Copper River Valley (in 1885), mapped five mountains over 12,000 feet high in the Wrangell group east of the river: Mt. Wrangell, Mt. Tillman, Mt. Sanford, Mt. Dunn, and Mt. Blackburn. Prospectors and others who first entered the valley thereafter in 1898 could, in several instances, locate only four such mountains. Up to the present year no attempt has been made to map the Wrangell group accurately. The mountain apparently missing was the "Mt. Tillman, 16,600 ft.," o Allen's map, the most southwestern of the whole group, which he mapped in the form of an ellipse.

When Mr. Dunn visited the slopes of Mt. Wrangell (17,500 feet) in 1900, various stories were current about this "Mt. Tillman." Some men denied and some affirmed its existence, and it was plain that the matter could not be settled without a trip to the spot on the map where Allen placed "Mt. Tillman." "For instance, Schrader in 1898 accepted its existence," said the speaker. "Lieutenant Babcock, 8th U. S. Cavalry, who was in the Copper River Valley in 1900, believed that Allen, on seeing Mt. Wrangell from two parts of the valley at different times, had reduplicated Wrangell. The clearness of the air, the amount of glaciated country in the valley, and the oval grouping of the peaks contributed to the confusion."

On August 12, 1900, Mr. Dunn made camp where, according to Allen's map, the northern slopes of his "Mt. Tillman" should have been; but south of him for thirty miles, until the coast mountains were reached, the country was absolutely flat. The mountain, where mapped, did not exist. The explanation of Allen's mistake then seemed to be that of Lieutenant Babcock and others.

Two days later, however, he camped between Mt. Wrangell and Mt. Dunn. According to compass observations, this point lay on a northeast-southwest line between a Mt. Sanford of Allen's map and its "Mt. Tillman." In line also with this point was that to the southwest, on Copper River, from which Allen, in his report, had drawn an outline of the Wrangell group as it appeared to him to lie against the horizon and undoubtedly made the observations which formed a basis for his map. From Mr. Dunn's camp, however, the sky-line of Mt. Sanford was identical with that drawn for Mt. Tillman on the outline. Mr. Dunn saw the Mt. Sanford of the map at exactly the same angle as Allen did, only he was much nearer to it. "Mt. Tillman" of the map having been proved non-existent, it was plain that Allen had confused Sanford and Tillman, not Wrangell and Tillman.

"The mistake in mapping could not have arisen," said Mr. Dunn, "if Allen had seen the group only from this point of view. A study of his itinerary clears the matter up, with the following explanation: Allen *outlined* the five mountains as if he saw them in a straight northwest-southeast line; he *mapped* them in an ellipse. In the outline Mt. Sanford appears as a minor peak of Mt. Dunn, northeast of Dunn and of the outlined Mt. Tillman (Mt. Sanford of the map)."

At the conclusion of Mr. Dunn's address, the President called for remarks from the members present.

Dr. William H. Dall referred to the fact that Lieutenant Allen had been the first American to get sight of the great peaks of the Copper River district. The first account of Mount Wrangell was by a Russian party under Branicoff, which went up the Copper River a little distance. The party aroused the enmity of the Indians, and every man was massacred. The

Indians, however, returned the note books to the Russian post. No exploration by Americans was done until the Alaska purchase. Lieutenant Allen deserved great credit for his persevering work, which was carried on with the greatest difficulty.

Mr. Marcus Baker stated that he enjoyed the lecture immensely, and especially commended the photographs which Mr. Dunn showed. He also wished to emphasize the magnificent work done by Allen, who was the first white man to cross from the coast to the river.

Mr. Alfred H. Brooks, who has general charge of the Alaska work carried on by the Geological Survey, stated that the peaks of the Wrangell group had not yet been mapped, and that very little had been learned since Allen's time. A party from the Geological Survey was to locate these peaks during the present summer. Mr. Brooks also alluded to the fact that Mr. Oscar Roan reported in '99 that one of the five peaks of the Wrangell group was missing.

The proceedings of the meetings of the Society on April 4 and 18 will be published in the June number of this Magazine.

LECTURES :

March 25.—Vice-President McGee in the chair. Afternoon course.

Dr. Charles H. Townsend gave an illustrated address on the "Problems of the Pacific—The Lesser Islands."

March 28.—Vice-President McGee in the chair.

Col. Wm. M. Black, Corps of Engineers, gave an illustrated address on "Cuba and Porto Rico."

April 2.—President Graham Bell in the chair. Afternoon course.

Hon. O. P. Austin gave an illustrated address on the "Problems of the Pacific—The Commerce of the Pacific," which will be published later.

April 9.—Vice-President McGee in the chair. Afternoon course.

Dr. McGee gave an address on the "Problems of the Pacific—The great Ocean in World Growth," which will be published later.

April 11.—Vice-President McGee in the chair.

Mr. C. E. Borchgrevink, Commander of the Borchgrevink Antarctic Expedition of 1898–1900, gave an illustrated lecture on "Antarctic Explorations, 1898–1900," which will be published later.

April 25.—President Graham Bell in the chair.

Mr. Robert M. Chapman, of the U. S. Geological Survey, gave an illustrated address on "Our Northern Rockies," which will be published later.

NOTICE OF PROPOSED AMENDMENTS

TO THE

BY-LAWS OF THE NATIONAL GEOGRAPHIC SOCIETY.

THE following amendments to the By-Laws of the National Geographic Society have been duly proposed, have been considered by the Board of Managers, and will come up for action at the regular meeting, to be held in the Assembly Hall of the Cosmos Club, on Friday evening, May 16, with the recommendation of the Board that they be adopted :

ARTICLE III.—*Membership.*

SECTION 1. Change to read : *The Society shall consist of members, honorary members, fellows, and patrons.*

SEC. 4. New section : *Fellows shall be persons engaged in scientific work pertaining to geography ; they shall be members of the corporation.*

SEC. 5. New section : *Patrons shall be persons interested in geography who have contributed one thousand dollars or more to the objects of the Society ; they shall be entitled to all the privileges of membership for life.*

SEC. 6. Substitute for old section 4 : *The election of members, honorary members, fellows, and patrons shall be entrusted to the Board of Managers.*

ARTICLE IV.—*Officers.*

SECTION 1. After the word "members," in each of the first two clauses, insert the words *or fellows.*

ARTICLE VI.—*Finances.*

SEC. 3. New section : *Fellows shall pay an iniation fee of ten dollars on notice of election.*

SEC. 4. Substitute for old section 3 : *Annual dues may be commuted for life by members or fellows on the payment at one time of fifty dollars.*

SEC. 5. Old section 4 changed by inserting after the word "members," in both the first and second clauses, the words *or fellows.*

SEC. 6. Old section 5.

ARTICLE VII.—*Meetings.*

SEC. 4. After the word "members" in the second clause insert the words *and fellows.*

VOL. XIII, NO. 6 WASHINGTON JUNE, 1902

THE NATIONAL GEOGRAPHIC MAGAZINE

THE NATIONAL GEOGRAPHIC SOCIETY EXPEDITION TO MARTINIQUE AND ST. VINCENT

THE National Geographic Society has sent three of its members on a special expedition to Martinique and St. Vincent to investigate the volcanic conditions of the West Indian regions. The distinguished scientists who make up the party are: Robert T. Hill, of the U. S. Geological Survey; Israel C. Russell, professor of geology in the University of Michigan, Ann Arbor, and Commander C. E. Borchgrevink, the Antarctic explorer, who has studied the volcanoes Erebus and Terror, the most southern volcanoes known on the face of the globe.

The expedition is the most important and best equipped commission ever sent out to study actual volcanic action. Results of great scientific and practical consequence may be expected to flow from their work. On their return to the United States they will report the results of their observations to the Society. This report, forming a series of illustrated articles, will be published in full in the journal of the Society, the NATIONAL GEOGRAPHIC MAGAZINE.

The expedition sailed from New York May 14, by special permission of President Roosevelt and Secretary Moody, on the *Dixie*, which carried the supplies bought with the $200,000 voted by Congress for the aid of the West Indian suf-

Robert T. Hill, Geologist

Member of the National Geographic Society Expedition to Martinique ferers. They arrived in Fort de France Wednesday morning, May 21, several hours after the second great eruption of Mount Pelée, which in violence exceeded the explosion of May 8.

In placing such a competent expedition in the field so promptly the National Geographic Society is rendering science and the advancement of knowledge a great service. It is most important from a scientific point of view that the general volcanic activity now devastating Martinique and St. Vincent and disturbing the West Indian region should be studied by specialists at the earliest possible moment. Not in history has such a favorable opportunity occurred for an investigation of the causes of volcanic and seismic action, of those hidden forces which, smothered in large measure in the bowels of the earth, occasionally burst forth with old-time fury and make or unmake great masses of land.

The most recent volcanic explosion of modern times, the explosion of Krakatoa in 1883, took place thousands of miles from the center of the world's scientific workers.

But in the present activity of Mount Pelée, of La Souffrière, and the uneasiness general throughout the Lesser Antilles, the scientists of the United States have a unique opportunity for investigation. The United States Government has no authority to expend money for scientific investigations in foreign territory. None of the scientific branches of the government, as the U. S. Geological Survey, was therefore in a position to send an expedition to Martinique. But the National Geographic Society, recognizing the importance of immediate investigation, has sent to the region of disturbance, at its own cost, three of the foremost authorities on volcanic action in the world.

Mr. Hill is well known as the author of "Cuba, Porto Rico, and the Other Islands of the West Indies" (The Century Co.) and numerous articles and government reports on the geography and geology of the West Indian group. He visited Martinique and St. Vincent several years ago. Dr. Russell is the head of the Department of Geology in the University of Michigan and the author of "Volcanoes of North America," a standard work on the subject.

Commander C. E. Borchgrevink

Member of the National Geographic Society Expedition to Martinique

RECENT EXPLORATION IN THE CANADIAN ROCKIES*

By Walter D. Wilcox

PART II

We decided to spend August 13 in an attempt to learn more about the surrounding region and for this purpose selected a high mountain north of our camp for ascent. Fortunately the weather was perfect. The entire forenoon was spent in climbing this peak, which turned out very interesting. The heavy bush was wet from the previous day's rain, and we were soaked in the first hour. On the higher slopes some very interesting fossil corals and shells were found. The summit, 8,780 feet high, was reached before noon. Both Bryant and I took angles and made complete photographic panoramas of the view, which was superb. The result of this climb made us more certain that we were approaching the Elk River, as the mountains toward the east resembled Dawson's description of them and ran in the right direction The valley below our camp apparently enters the Elk ten miles or so to the southeast, but a better route appeared over a pass to the north. On the open and flat summit of this mountain two species of butterflies were seen and several flowers, among them a bright yellow erigeron and a leguminous plant closely resembling a violet in general outline.

Lusk and Wood had been sent to explore the lower part of the valley and were back when we reached camp. They said they had gone down to where a large stream comes in from the north, and had found a good trail ascending the latter. They brought in a canvas-back duck, which proved very tender and fine-flavored. In the afternoon, with the assistance of Woodworth, our best axeman, I laid out a base line half a mile above our camp to triangulate my survey stations. At night I changed two dozen plates for my cameras under a dark-room teepee made of blankets thrown over poles. The rapidity of our movements and the continuous fine weather, of which we took advantage, gave no time for rest or repose.

The next day we made a rapid and uninterrupted march of four hours. After five miles through green timber we reached a wide meadow, much used by the Indians as a camping ground. Here we turned at right angles, to the left, and marched four miles upstream and camped near the base of what we thought was a pass to the north.

Tom Lusk went up the valley to locate the trail for the next day's march, but came back an hour later and said there was only the faintest kind of a trail a mile above camp, while a little farther on it totally disappeared. With our field-glasses we could see no sign of a trail on the pass ahead, and, as we knew from the previous day's climb that this was the only possible outlet, it seemed that we had marched into a "blind valley," or cul-de-sac. Indian trails rarely ascend such valleys unless the region is exceptionally good for game. After this discouraging news I set out to learn a little more, if possible, and, instead of following the valley, commenced a gradual ascent of the slopes on the east. After an hour's climb I got a fair view of one of the two

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*The first part of this very interesting paper by Mr. Wilcox appeared in the May number.

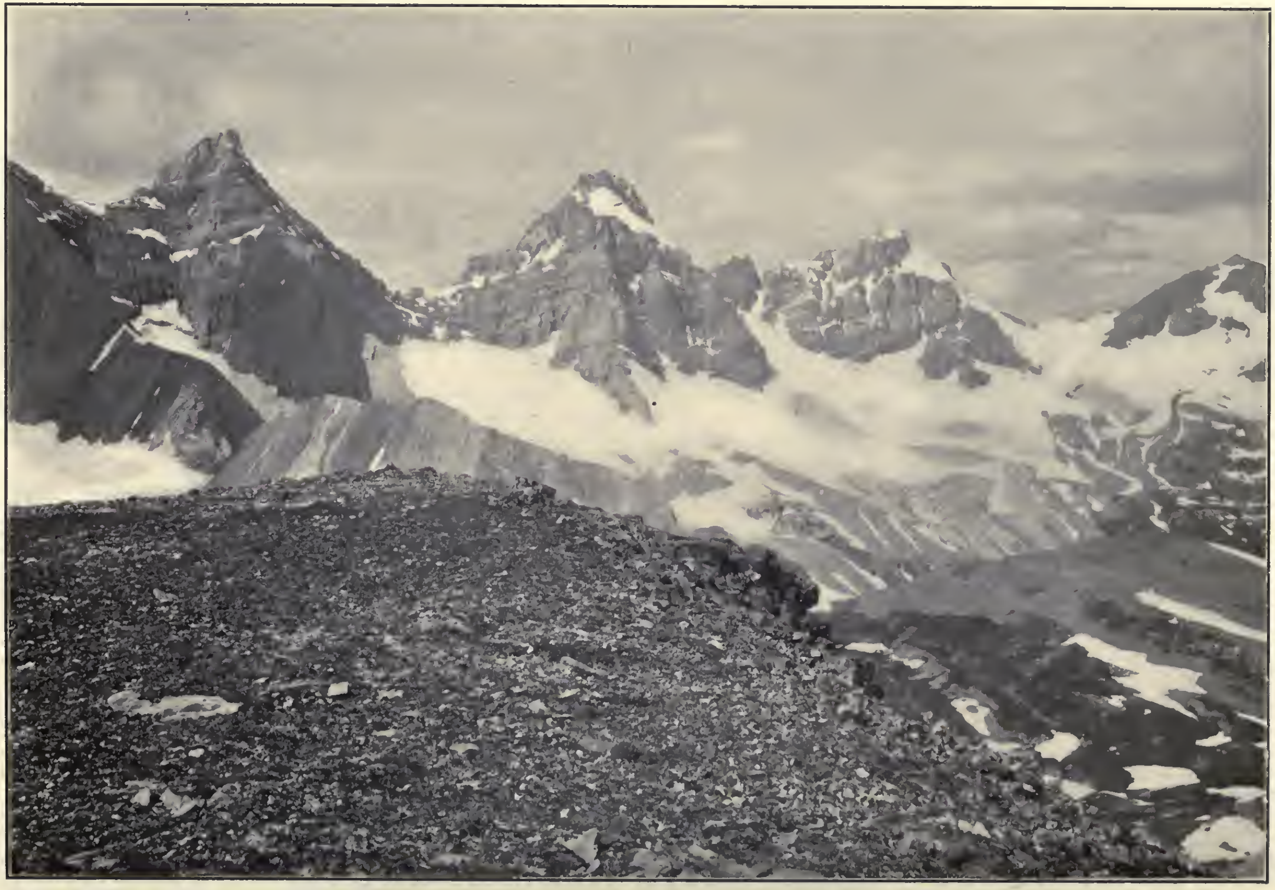

Photo by Wilcox

Second Range West of the Elk

lakes which Tom said he had seen at the end of our valley. Though I went on for another half hour, I could not see the other lake, owing to an exasperating ridge which remained in the way. It was now so late that I was forced to return by way of the valley. The lake is apparently very beautiful, as four high connected peaks lie behind it and are flanked by glaciers at their bases. The lake is surrounded by woods and cliffs, which on the north side rise out of the water abruptly. I regretted that it was impossible to visit that interesting spot, but it was now so late that I had to return to camp on account of darkness.

Photo by Wilcox

Camping in the Elk Valley

The atmosphere was so clear in the night that three satellites of Jupiter could be seen with our field-glasses. In the morning there was much frost and ice and a conspicuous absence of "bulldogs." It seems remarkable that the mountain plants and delicate flowers are not injured by temperatures below the actual freezing point, not only here, at altitudes of 6,000 feet, but even 2,500 feet higher, at the upper limit of plant life, where the cold is far more severe.

For the first time on our trip a retreat was necessary, and we marched rapidly back to the junction of the two streams. Shortly beyond this the flat, meadowy character of the valley ends, and the trail ascends one of two curious moraine-like ridges which descend into the valley on either side and seem to make a kind of dam. Crossing this, we were soon in a wild gorge, with a roaring torrent below us and magnificent spruce trees of great height on every side. This change from the quiet stream and open meadows was one of those sudden and surprising transformations that add so much to mountain travel. The trail turned more and more toward the east and northeast, through the finest timber I have ever seen in this range. Many of the spruces were not less than one hundred and sixty feet high. Unfortunately, the ground was covered by many fallen forest giants too large for the Indians to cut out, and the trail made such a number of turns that our horses could be seen going in different directions several times in the length of our procession. After six hours of tiring march, a rapid descent brought us to the bottom of a wide valley with a deep stream flowing south. This we knew from Dawson's map and description to be the Elk River. After fording the river our camp was placed in a delightful meadow. Bryant caught two trout before lunch was ready, and these were the first fish we had seen in many weeks. In the afternoon enough fish were caught to supply the entire party with dinner and breakfast.

This part of the Elk River has been described by Dawson. It is very wide and flat, with a number of meadows interspersed among burned forests. The valley in the meadows by the river and in the occasional spots of green forest is picturesque, but otherwise the vast waste of burned timber and the monotonous and uniform mountains on either side have a desolate aspect.

The following day was warm and quite smoky from forest fires. We made an uninteresting and fatiguing march of six hours to the divide between the Elk and Kananaskis Rivers. The fallen timber and obscure trail gave us very

Photo by Wilcox

Making Camp After a Hard Day's Journey

much trouble, and we could only make one or two miles an hour by having two axemen ahead to cut timber constantly. We camped near the pass which, according to our aneroids, is 6,440 feet, or sixty feet lower than Dawson's estimate.* Exactly opposite the pass on the west is a large gap, from which the source of the Elk River, a large and muddy stream, comes into the broad and nearly straight depression, forty miles long, occupied by the upper Kananaskis and Elk Rivers. I was anxious to explore this, but three miles of impassable timber intervened, and this region was postponed till after the Kananaskis Lakes were reached.

The next day was warm, and we were annoyed by numbers of mosquitoes and small black flies, which rise in swarms from the grass and bush. They are not so bad till the bush is shaken, and consequently those in front of the procession suffer little, while those in the rear can hardly see or breathe at certain times. I found three mosquitoes on different occasions carrying the pollineum of some kind of orchid, probably one of the common species found in every swamp, attached to the head. No doubt these mosquitoes had been imitating bees or other insects by drawing nectar from the blossoms.

It required nearly six hours to reach the Kananaskis Lakes, which we first saw from a wooded ridge three or four miles distant. Camp was placed on the large river connecting the two lakes. It was with not a little pleasure that we settled ourselves at length on the shores of these lakes after fifteen days marching to reach them. Here for the first time our folding boat was set up for the purpose of exploring and fishing trips. It looked frail, but we found it to work well and capable of holding three men safely. Bryant succeeded in catching a number of fine trout in time for dinner. Our camp was picturesquely located on a wooded bank of the river, which has a large volume of water and is perfectly clear. The neighborhood seems to abound in every kind of game, and made an acceptable change from the comparatively lifeless region which had recently been traversed. Wild ducks and geese flew constantly by our camp, using the river as a route between the two lakes, and several flocks of ducks were constantly visible on the lake from our camp. The bottom of the lake near the shore is covered by several species of water plants, whose long stems wave gently in the current of the inlet stream, and the surface of the water is constantly ringed by trout rising to flies. We were startled at evening and after nightfall by the melancholy cry of the loon, the hooting of owls, and other mysterious sounds made possible by lynxes or mountain lions.

A week was spent at the Kananaskis Lakes, in which our time was very fully occupied in survey work and exploration of the surrounding region. On the second day we moved camp to the upper lake, which is not half a mile distant. It is 60 feet higher, and separated from the lower lake by a long rock ridge. From our tent we looked out on a revelation of beauty hardly equaled anywhere in the mountains. This lake is pear-shaped and about two miles in diameter. It is encircled by very high mountains of the main range of the Rockies, and has four large islands and several small islets, all densely wooded, which give an endless variety of view from various points. The water is perfectly clear, but not very blue, like most mountain lakes, and the shores, where not abrupt, are lined with a black shaly gravel. No fish were ever seen or caught in this lake, while the lower lake abounds in them.

I had planned for a trip to the Kananaskis Pass on the 20th in order to learn its location, altitude, and other

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* For map see p. 167, May, 1902, NAT. GEOG. MAG.

Photo by Wilcox

"Our camp was pitched on a wooded bank"

interesting details. This seemed the most important piece of work near the lakes, especially as nothing is given on Dawson's map except a reported altitude of 6,200 feet and the presence of a lake draining west on the top of the pass. These details were taken from Palliser's narrative, written half a century ago. The fact that he was probably the last if not the only white man to have crossed this part of the Rockies, to say nothing of a desire to see at what point on our way down the Palliser River we had overlooked the pass, made me very anxious to explore that region. Bryant, who was enjoying fine fishing every day in the lower lake, did not care to join in this trip.

Unfortunately the weather of late had been giving every indication of an approaching storm, the air being warm and smoky, with heavy fogs in the early mornings. On the appointed day we were awakened by thunder in the mountains west of us, and not long after dark clouds settled over the lake and brought rain. We were compelled to wait till 9 o'clock before there was enough promise of good weather to warrant a start. It was perhaps imprudent to attempt to reach the summit of a great pass and return to camp in one day, especially after a late start and in bad weather. I took Jim Wood with me, a half-breed who acted as our second packer, and two saddle horses, one of which had first been with me on a trip up the Bow River six years before. We carried a small camera, an axe, and various instruments for rough survey work, besides a lunch of bannock and canned meat. The trail first skirts the lake on the north shore, and then turns west into heavy timber. The woods were dripping and a drizzling rain kept falling, but we made fair time except for a few logs which had to be cut out. This was miserable, cold work and meant

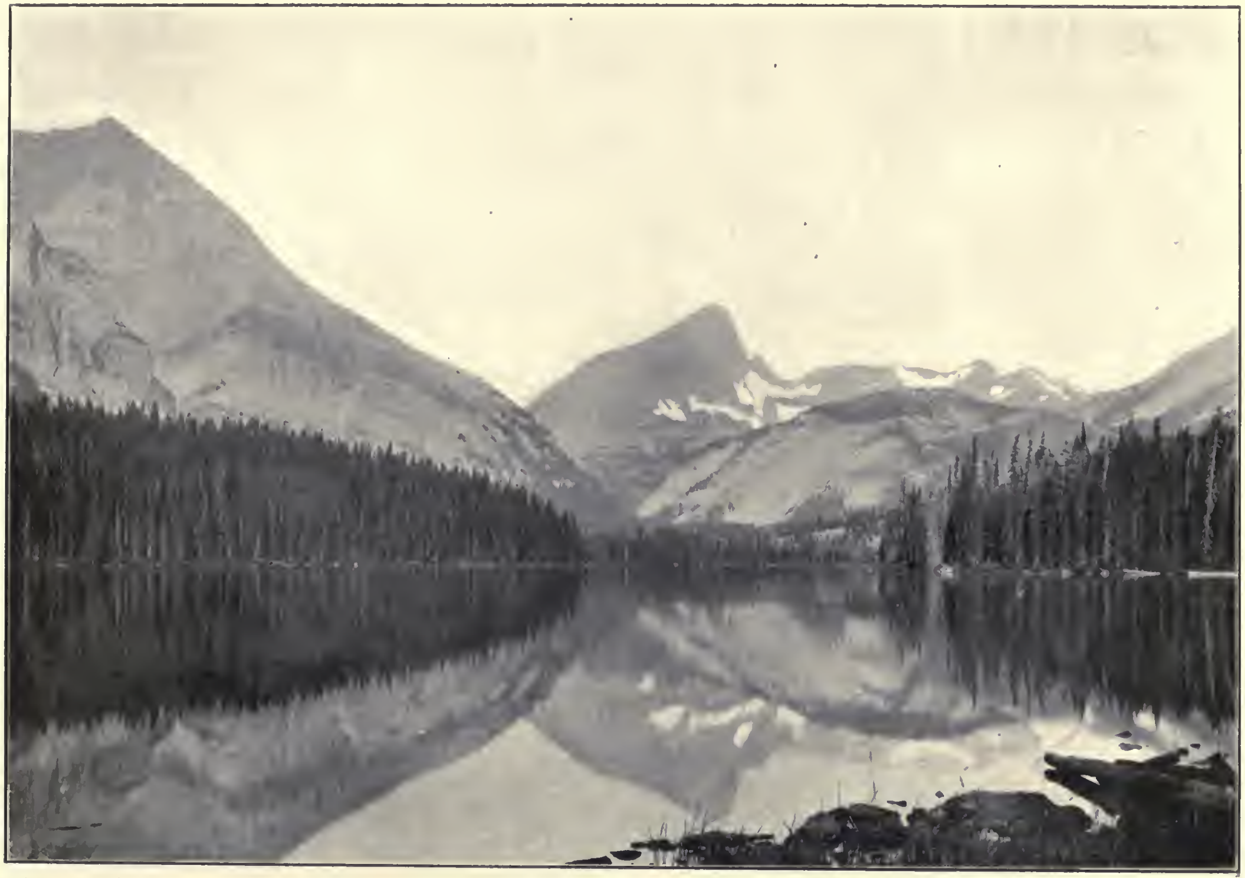


Photo by Wilcox

Upper Kananaskis Lake Looking Toward Pass getting wet in spite of long rain coats, as we had to tie or hold our horses each time for fear they would escape and go back to camp to join the other animals. Nothing is more trying to Indian ponies than separation from their associates, especially after they have been long together. About one mile from the lake we came to a meadow and forded the river which comes from the pass. This was the first time we had seen the Kananaskis before it enters the lake, and we were surprised at the considerable volume of water. It is muddy and of that peculiar color we had seen in the Palliser. The valley soon became narrow and wild, with a rough trail ascending a wooded ridge. Here the stream banks have been undermined and the trees thrown into the water. This made a partial dam and forced the river to undermine further, continuing the process, so that there were several acres of fallen timber in the stream bed. The trail itself had been washed out and ended in a place where, from the depth and swiftness of the current, it was impossible to touch bottom with poles. We had to find another place, and at length came out on an open gravel wash and easier travel. The pass is here most imposing. We were surrounded by very steep and craggy mountains, their tops covered by clouds, while the green forests below were partly concealed by clinging mists rising from the saturated ground. The swift rush of the river and the occasional rumble of thunder, echoing among the cliffs, added to the impressive grandeur of our surroundings.

Photo by Wilcox

Named by Mr. Wilcox "Lawson Lake"

The trail turned at length to our right or to the north. This development took away our hope that the pass lay near us to the west. After three hours' hard travel we were not 300 feet above the altitude of the lake, and were turned north in a long valley parallel to the summit range. It now seemed very unlikely that the summit could be reached that day, but the trail soon made a sudden and unexpected ascent of the slope on the west side of the valley. After a tedious climb of 1,300 feet, we reached the end of a short valley with a steep glacier at the end partly covered by coaly-black shale. No outlet for a pass was visible. The trail then led across the valley stream and over a ridge, where we had lunch by a small lake.

The clouds now began to lift a little. Leaving Wood to attend to the horses, I hurried off to cross a ridge half a mile ahead, which I thought was the summit of the Kananaskis Pass. As five hours had been spent in reaching this point, I told Wood that I would be back in an hour, as that would only leave us enough time to reach camp before nightfall. Shortly after leaving Wood I saw a beautiful lake through the larch trees. Some rugged mountains beyond were reflected in its surface, which lay like a vast mirror in the calm air. Here I made sketches and took photographs. Then, after leaving the field-glasses on a scrubby spruce, out of the way of picas and marmots, which were squeaking and whistling on every side, walked rapidly to the other end, thinking this was the lake reported by Palliser on the summit of the pass. There was no visible outlet to the lake. Its waters sink underground somewhere, though a dry channel leads out at the north end and the lake shores show that the water level is sometimes several feet higher.

The trail seemed to descend into a depression toward the north, but I now suspected that this was not the pass summit. My time was now exhausted, and though a cold night in wet woods was risked I felt the necessity of determining whether this was indeed the highest point. Feeling the need of making fast time, I left my camera and coat on another bush and started on a trot down the trail. Here, in five minutes, the trail came to a small stream and turned sharply to the west, toward a pass which I roughly estimated to be 8,000 feet high and so far away as to mean an hour's hard work.

Failure to reach the Kananaskis Pass now seemed more certain than ever. In spite of prudence and the warning of my watch, I felt that too much was at stake to give up reaching the summit now. The cool air was exhilarating, but one can not long continue violent physical exercise at 7,000 feet above sea, especially on a rough and ascending trail. I recall splashing through an icy stream, and then a half-mile run through a hummocky meadow, where I caught a swift glimpse of a glacier and its huge morainal stones on my left; finally the steep and heart-breaking ascent of a narrow ravine, where a pretty rivulet was hushed under banks of snow. The last Alpine flowers, the rushing streams, and the whistling marmots of the upper meadows were left behind, and I approached a barren ridge. Looking over this, I saw a desolate lake surrounded by bare cliffs and the awful solitude of that half-way belt which has neither the beauty of the green valleys nor the grandeur of great snow-fields. I ran along the muddy shores and through snow banks to the other end; then, ascending to the crest of a ridge at 7,805 feet, stood on the top of the Kananaskis Pass at 4 o'clock. There was, besides the flush of exercise, something impressive in the wild solitude of that barren place, of the gloomy sky overhead, and the vast outlook on an unknown wilderness. Hither none, except perhaps the Indian, had come since Palliser, fifty years before, and even now, outside of our little band at the lake, probably no white man was nearer than twenty miles in any direction. Here I looked down into a desolate valley 2,500 feet below, where a muddy stream coming from a high peak north enters the Palliser River. I recognized the location of our first camp in the Palliser, where, in the maze of burned timber and side trails of an Indian camp, we had overlooked the Kananaskis Pass. After ten minutes on the summit, I commenced a rapid return, running and walking to the first lake. The clouds had lifted on the high mountains to the north, revealing a very large glacier. In the golden light of evening, for the sun was breaking through the storm, the lake resembled a great mirror, and the clouds were rolling over the cliffs and assuming fantastic forms. Even in my haste to gather up the various articles left here, I appreciated that rarely or never had I looked upon a more beautiful scene. I named this Lawson Lake.

It required an hour to reach Wood and the saddle horses. We started at 5.15, and made a desperate effort to reach camp before nightfall. Running our horses wherever possible, and they were more than willing to return, we reached camp in three hours, just as night appeared. Two Stony Indians were standing by our camp fire as we approached.

Bryant said he had spent an interesting day, and while fishing in the lower lake had seen a long file of Indians coming down the north shore. They shouted, "Come here." Feeling certain that they were Stonies, a very friendly tribe, he visited them without fear. The canvas canoe, his silk fishing lines, and wonderful display of artificial flies excited their utmost surprise and admiration. An old man conversed with Bryant through one of the young bucks as interpreter. The latter receive a good education at the schools on the reserve at Morley. Some of the conversation was as follows:

"Where you come from?" "Banff." "How many in your party?" "Five." "You catch many fish?" "A few." "Old man says this is Stony Lake. No like it white man catch fish here." To this Bryant replied that he would catch as many as he wanted to eat.

"You shoot goat?" "No." "You shoot sheep?" "No." "You shoot elk?" "No." "Bear?" "No." "What you shoot?" "Nothing. We came here to see the country." At this there was a shout of derisive laughter and loud talking for a long time. Later three of the Indians came up to our camp and had dinner, but Ben Woodworth said it was almost impossible to fill them up, and that there would have been nothing for us if he had given them all they wanted.

The Indians told us that the pass visited that day was the Kananaskis, and that it was two "sleeps" to the Kootenai, by which they mean the Palliser River or any stream on the other side of the divide. The Stonies, so far as I have been able to find out, have no local names for anything except the great passes, and these names they have adopted more or less from the white man. That we had covered the equivalent of three days' travel in eleven hours shows how rapidly we had traveled.

I tried to get some information from the most intelligent of the young bucks, but without much success. They said there was a lake a mile or two long in the next valley to the south, the head of the Elk, which we had not visited. They knew of the high pass which we had crossed on August 12, and expressed the greatest surprise that we had gotten our horses over it. The Indians were disgusted that we had shot no game, and that we were at the "Stony Lake." This term they apply only to the long lower lake, which is full of fish, and

Photo by Wilcox

Storm on Kananaskis Lake

said we could have the other, which has none, but is far more beautiful. There is no beauty or grandeur in the mountains for them, where they suffer cold and privation only to fill their flesh pots.

The next morning about 9 o'clock the whole troop filed by our camp, which was placed almost on the trail. There were about twenty or thirty Indians and about fifty horses in their outfit. The oldest men came first, then the young bucks. Later came the squaws, many of whom had papooses strapped on their backs or placed in the saddle just behind the high Mexican pommels. One little child, not four years old, was fastened in a kind of basket on a gentle pony and allowed to shift for himself. Many of the bucks said, "Good morning," or saluted in some way, but most of the women looked straight ahead, as though we were not visible. The younger girls were evidently embarrassed, but the old squaws made remarks and were interested in our teepee, which no doubt partially won their hearts. All the women drove two or three ponies each, some of which were running loose, and others curiously

Photo by Wilcox

Falls Near Kananaskis Lake

packed with skins of wild animals and leather thongs. They speak very quietly, or make a gentle, hissing noise to their horses, when they go wrong, as they all did at suddenly seeing our camp. This manner of driving is entirely different from the vociferous shouts and curses of the average white packer. Fully fifteen minutes elapsed while this interesting procession was passing.

The canvas boat had been carried to the upper lake, where we were now located. After several preliminary excursions, Bryant and I made a visit to a valley directly across the lake. Our chief object was to see a large waterfall, which, though fully four miles distant, could be easily seen and heard from our camp. Our course down the lake lay between some heavily wooded islands, and as the water was perfectly calm the views on every side were most attractive. The other side was reached after 35 minutes steady rowing, and a landing was made near where the Kananaskis River enters the lake We were drawn a little out of our course by hearing the sound of falling water coming mysteriously from a densely wooded bank. Here a curious spring bursts out of the ground and discharges enough water to make a fair-sized stream. To ascend the valley we had first a ridge to cross, involving a climb through an almost impenetrable forest. With our heavy cameras and other necessaries it was exceedingly trying work, pushing aside stout, young trees, crawling under logs or over great windfalls, all so closely set together as to resemble a hedge. After half an hour of this we reached the top and were descending the other side when a lake appeared below. Though surrounded by woods, the trees all ceased to grow at a level about 20 feet above the water, and the intervening space was thickly overgrown by cow parsnips and tall grasses. Across this sheet of muddy water a large stream could be seen foaming into the lake from a canyon. Skirting the shore, we followed a kind of trail made by elk through a dense wood. In half an hour we were well up an open valley into which the falls plunge. Though the volume of water in these falls is large, we were somewhat disappointed by their height, which, according to an estimate by aneroid and level, is only 150 feet.

While I was photographing, Bryant had nearly reached the top of the cliff by a narrow couloir. Thinking he intended to explore the upper valley, I followed, but upon reaching the top it was impossible to follow his tracks in the heath-like moss and through open woods The country was park-like, but many limestone ridges and miniature cliffs, alternating with Alpine flower gardens, giving a wonderful display of purple asters and bright yellow erigerons, made progress slow. On one slope of broken stones I saw a great number of curious fossils, resembling a goat horn in appearance and lying loose in the debris. Similar ones were seen later embedded in almost every cliff, together with many fine coral fossils, one of which was 18 inches in diameter. Finding no accessible valley to the south, from which I had hoped to get a view into the unseen valley, where the Elk River heads, I turned west and found a lake half a mile long at the base of a long glacier. This mass of ice covers the north and west slopes of the high mountains east of the Palliser River which had caused us to travel so far south. One glacier is about five miles long. The lake rests in a basin of solid rock and the outlet stream rushes into a small canyon and is very swift and full of cascades all the way to the great falls which we had seen below.

A storm was coming up and I hastened back to the falls, which were reached in an hour. Here I saw Bryant on the opposite side of the stream trying to cross the canyon by building a bridge of logs. All but one fell short, and I advised not trying to cross here, as it was a terrible place to slip. Thus we had to travel on opposite sides all the way to the first lake we had discovered. Here I built a fire to keep warm while Bryant made a rough passage over the cliffs on the opposite side and finally appeared at the lake, having found a log jam above.

This lake has no outlet, though an ancient channel serves as an overflow in time of flood. Thus the trees cease to grow at the certain level where the outlet allows no farther rise. We followed the canyon made by the former stream, and only after an hour of the most difficult bush work I have ever seen, we reached the lower lake at the great spring near which our boat had been tied. We now felt certain that this was one of the underground outlets of the upper lake.

That night the moon broke through the clouds and flooded the lake with soft light, bringing the heavily wooded islands into strong relief. From our tent door we could see, beyond the broad expanse of water, a grand picture of dark mountains inclosing a silvery ice field, and through the calm night air we could hear distinctly the falls we had visited that day with so much difficulty.

Photo by Wilcox

Fording the Kananaskis

The next day was to be our last at the Kananaskis Lakes, and was full of activity. In the morning I made a panorama of eight plates from one of the islands. Unfortunately most of this series, after escaping the perils of the wilderness and three or four hundred miles on the back of an Indian pony, fell victims to the baggage-smasher on their eastward journey.

After lunch I carried my camera to the top of a mountain 3,000 feet above our camp, or 8,700 feet above sea-level. This peak lies north of the lakes and is comparatively easy of ascent. The entire east side is a steep grassy slope, which ends abruptly in a jagged edge of cliffs. Looking over this to the west, one stands on the sharp crest of a tremendous precipice of very unusual formation. It is no less than a perfectly smooth wall, which sweeps out of the valley in a magnificent curve more than 2,500 feet in height to the rough edge of the arête. This narrow ridge is crowned, far above tree line, by scrub spruce trees, gnarled and distorted by wind into weird and fantastic shapes. The dwarf Alpine flowers were also interesting. I found some golden rod in full blossom, with stems and flowers perfectly developed, not more than one and one-half inches high. Far more exceptional was the discovery of some *epilobium* (*latifolium*), a beautiful plant related to the fireweed of the lower valleys, at 8,500 feet altitude, which is almost 1,000 feet above previous records. The last part of the climb was more rugged, and involved several hundred yards along a knife edge at the summit. Two eagles were perched on the highest crag as I approached. A vast panorama, including the upper Kananaskis and Elk Valleys, with the Opal and Mist Mountains beyond and the main range of the Rockies on the other side, was disclosed from this peak and made a fine reward for the climb. The ridge crest was so narrow that I could not stand behind the camera, but had to focus and expose plates by a method adapted to such emergencies. Fortunately the wind, which was blowing very strong in the valleys, as I could see by the white caps on the lakes, was only a gentle and unusually warm breeze at this great height.

We left the Kananaskis Lakes to follow the river back to the railroad on August 24. Owing to a serious error in Dawson's map of this region, we lost nearly two days' time by following a wrong trail, which, after leading us through miles of muskegs and burned timber, brought us to a gap in the Mist Mountains, with no sign of a trail going down the Kananaskis. On the second day at noon we found ourselves back at our starting point, but satisfied now to follow the trail which the Indians had used. Our march down the Kananaskis was accomplished in three long days' march, the last 20 miles of which were much facilitated by the now disused lumber road.

The original plan of our exploration was reversed—first by the fact that the upper Spray Valley does not lead directly to the Kananaskis Lakes, as Dawson's map surmises, and then because we missed the opening to the pass itself later. This in nowise defeated our object, and undoubtedly the accident led us into as interesting discoveries as would have been otherwise possible.

After comparing a sketch of the country we passed through with Dawson's map of the region, on either side some interesting facts are disclosed. Among them it seems that the second valley we had discovered east of the Palliser, and which we entered on August 10, is probably not a tributary to the Elk, though we had first thought it was. Where we left this valley the altitude is 5,060 feet, or nearly 300 feet lower than the Elk at a corresponding point due east. The Elk Valley is known to have very little fall in that region, and it hardly seems possible that this river, which runs south eight degrees west, enters the former and has a still less descent. Moreover, in case there is such a gentle fall to the Elk, there should be an abundance of fish, which is not the case. I am inclined to think this is the source of the Bull River.

The actual time devoted to reaching and exploring this region, exclusive of our Assiniboine trip, was four weeks. The fact that not more than one-tenth of Dawson's "blank area" was investigated in that time, under every favorable circumstance of fine weather, competent men, and excellent outfit, gives an idea of the vast amount of work that still remains for future exploration.

THE ERUPTION OF KRAKATOA

BY SIR ROBERT BALL

The following description by Sir Robert Ball of the eruption of Krakatoa will be read with special interest at the present time. It is taken from his book, "The Earth's Beginning," just published by D. Appleton & Co., and which is reviewed on another page of this number.

UNTIL the year 1883 few had ever heard of Krakatoa. It was unknown to fame, as are hundreds of other gems of glorious vegetation set in tropical waters. It was not inhabited, but the natives from the surrounding shores of Sumatra and Java used occasionally to draw their canoes up on its beach while they roamed through the jungle in search of the wild fruits that there abounded. Geographers in early days hardly condescended to notice Krakatoa. The name of the island on their maps would have been far longer than the island itself. It was known to the mariner who navigated the Straits of Sunda, for it was marked on his charts as one of the perils of the intricate navigation in those waters. It was no doubt recorded that the locality had been once, or more than once, the seat of an active volcano. In fact, the island seemed to owe its existence to some frightful eruption of bygone days, but for a couple of centuries there had been no fresh outbreak. It almost seemed as if Krakatoa might be regarded as a volcano that had become extinct. In this respect it would only be like many other similar objects all over the globe, or like the countless extinct volcanoes all over the moon.

In 1883 Krakatoa suddenly sprang into notoriety. Insignificant though it had hitherto seemed, the little island was soon to compel by its tones of thunder the whole world to pay it instant attention. It was to become the scene of a volcanic outbreak so appalling that it is destined to be remembered throughout the ages. In the spring of that year there were symptoms that the volcanic powers in Krakatoa were once more about to awake from the slumber that had endured for many generations. Notable warnings were given. Earthquakes were felt, and deep rumblings proceeded from the earth, showing that some disturbance was in preparation, and that the old volcano was again to burst forth after its long period of rest.

At first the eruption did not threaten to be of any serious type. In fact, the good people of Batavia, so far from being terrified at what was in progress in Krakatoa, thought the display was such an attraction that they chartered a steamer and went forth for a pleasant picnic to the island. Many of us, I am sure, would have been delighted to have been able to join the party who were to witness so interesting a spectacle. With cautious steps the more venturesome of the excursion party clambered up the sides of the volcano, guided by the sounds which were issuing from its summit. There they beheld a vast column of steam pouring forth with terrific noise from a profound opening about thirty yards in width.

As the summer of this dread year advanced, the vigor of Krakatoa steadily increased. The noises became more and more vehement. These were presently audible on shores ten miles distant, and then twenty miles distant, and still those noises waxed louder and louder, until the great thunders of the volcano, now so rapidly developing, astonished the inhabitants that dwelt over an area at least as large as Great Britain, and there were other symptoms of the approaching catastrophe. With each successive convulsion a quantity of fine dust was projected aloft into the clouds. The wind could not carry this dust away as rapidly as it was hurled upward by Krakatoa, and accordingly the atmosphere became heavily charged with suspended particles. A pall of darkness thus hung over the adjoining seas and islands. Such was the thickness and the density of these atmospheric volumes of Krakatoa dust that for a hundred miles around the darkness of midnight prevailed at midday. Then the awful tragedy of Krakatoa took place. Many thousands of the unfortunate inhabitants of the adjacent shores of Sumatra and Java were destined never to behold the sun again. They were presently swept away to destruction in an invasion of the shore by the tremendous waves with which the seas surrounding Krakatoa were agitated.

Gradually the development of the volcanic energy proceeded, and gradually the terror of the inhabitants of the surrounding coasts rose to a climax. July had ended before the manifestations of Krakatoa had attained their full violence. As the days of August passed by, the spasms of Krakatoa waxed more and more vehement. By the middle of that month the panic was widespread, for the supreme catastrophe was at hand.

On the night of Sunday, August 26, 1883, the blackness of the dust clouds, now much thicker than ever in the Straits of Sunda and adjacent parts of Sumatra and Java, was only occasionally illumined by lurid flashes from the volcano. The Krakatoan thunders were on the point of attaining their complete development. At the town of Batavia, a hundred miles distant, there was no quiet that night. The houses trembled with the subterranean violence, and the windows rattled as if heavy artillery were being discharged in the streets, and still these efforts seemed to be only rehearsing for the supreme display. By ten o'clock on the morning of Monday, August 27, 1883, the rehearsals were over and the performance began. An overture, consisting of two or three introductory explosions, was succeeded by a frightful convulsion which tore away a large part of the island of Krakatoa and scattered it to the winds of heaven. In that final effort all records of previous explosions on this earth were completely broken.

This supreme effort it was which produced the mightiest noise that, so far as we can ascertain, has ever been heard on this globe. It must have been indeed a loud noise which could travel from Krakatoa to Batavia and preserve its vehemence over so great a distance; but we should form a very inadequate conception of the energy of the eruption of Krakatoa if we thought that its sounds were heard by those merely a hundred miles off. This would be little indeed compared with what is recorded, on testimony which it is impossible to doubt.

Westward from Krakatoa stretches the wide expanse of the Indian Ocean. On the opposite side from the Straits of Sunda lies the Island of Rodriguez, the distance from Krakatoa being almost 3,000 miles. It has been proved by evidence which cannot be doubted that the thunders of the great volcano attracted the attention of an intelligent coastguard on Rodriguez, who carefully noted the character of the sounds and the time of their occurrence. He had heard them just four hours after the actual explosion, for this is the time the sound occupied on its journey.

We shall better realize the extraordinary vehemence of this tremendous noise if we imagine a similar event to take place in localities more known to most of us than are the far Eastern seas.

If Vesuvius were vigorous enough to emit a roar like Krakatoa, how great would be the consternation of the world! Such a report might be heard by King Edward, at Windsor, and by the Czar of all the Russias, at Moscow. It would astonish the German Emperor and all his subjects. It would penetrate to the seclusion of the Sultan at Constantinople. Nansen would still have been within its reach when he was furthest north, near the Pole. It would have extended to the sources of the Nile, near the Equator. It would have been heard by Mohammedan pilgrims at Mecca. It would have reached the ears of exiles in Siberia. No inhabitant of Persia would have been beyond its range, while passengers on half the liners crossing the Atlantic would also catch the mighty reverberation. Or, to take another illustration, let us suppose that a similar earth-shaking event took place in a central position in the United States. Let us say, for example, that an explosion occurred at Pike's Peak as resonant as that from Krakatoa. It would certainly startle not a little the inhabitants of Colorado far and wide. The ears of dwellers in the neighboring states would receive a considerable shock. With lessening intensity the sound would spread much farther around—indeed, it might be heard all over the United States. The sonorous waves would roll over to the Atlantic coast; they would be heard on the shores of the Pacific. Florida would not be too far to the south, nor Alaska too remote to the north. If, indeed, we could believe that the sound would travel as freely over the great continent as it did across the Indian Ocean, then we may boldly assert that every ear in North America might listen to the thunder from Pike's Peak, if it rivalled Krakatoa. The reverberation might even be audible by skin-clad Eskimos, amid the snows of Greenland, and by naked Indians sweltering on the Orinoco. Can we doubt that Krakatoa made the greatest noise that has ever been recorded?

Among the many other incidents connected with this explosion, I may specially mention the wonderful system of divergent ripples that started in our atmosphere from the point at which the eruption took place. I have called them ripples, from the obvious resemblance which they bear to the circular expanding ripples produced by raindrops which fall upon the still surface of water. But it would be more correct to say that these objects were a series of great undulations which started from Krakatoa and spread forth in ever-enlarging circles through our atmosphere. The initial impetus was so tremendous that these waves spread for hundreds and thousands of miles. They diverged, in fact, until they put a mighty girdle round the earth, on a great circle of which Krakatoa was the pole. The atmospheric waves, with the whole earth now well in their grasp, advanced into the opposite hemisphere. In their farther progress they had necessarily to form gradually contracting circles, until at last they converged to a point in Central America, at the very opposite point of the diameter of our earth, 8,000 miles from Krakatoa. Thus the waves completely embraced the earth. Every part of our atmosphere had been set into a tingle by the great eruption. In Great Britain the waves passed over our heads, the air in our streets, the air in our houses, trembled from the volcanic impulse. The very oxygen supplying our lungs was responding also to the supreme convulsion which took place 10,000 miles away. It is needless to object that this could not have taken place because we did not feel it. Self-registering barometers have enabled these waves to be followed unmistakably all over the globe.

Such was the energy with which these vibrations were initiated at Krakatoa, that even when the waves thus arising had converged to the point diametrically opposite in South America their vigor was not yet exhausted. The waves were then, strange to say, reflected back from their point of convergence to retrace their steps to Krakatoa. Starting from Central America, they again described a series of enlarging circles, until they embraced the whole earth. Then, advancing into the opposite hemisphere, they gradually contracted until they had regained the Straits of Sunda, from which they had set forth about thirty-six hours previously. Here was, indeed, a unique experience. The air waves had twice gone from end to end of this globe of ours. Even then the atmosphere did not subside until, after some more oscillations of gradually fading intensity, at last they became evanescent.

But, besides these phenomenal undulations, this mighty incident at Krakatoa has taught us other lessons on the constitution of our atmosphere. We previously knew little, or I might almost say nothing, as to the conditions prevailing above the height of ten miles overhead. We were almost altogether ignorant of what the wind might be at an altitude of, let us say, twenty miles. It was Krakatoa which first gave us a little information which was greatly wanted. How could we learn what winds were blowing at a height four times as great as the loftiest mountain on the earth and twice as great as the loftiest altitude to which a balloon has ever soared. We could neither see these winds nor feel them. How, then, could we learn whether they really existed? No doubt, a straw will show the way the wind blows; but there are no straws up there. There was nothing to render the winds perceptible until Krakatoa came to our aid. Krakatoa drove into those winds prodigious quantities of dust. Hundreds of cubic miles of air were thus deprived of that invisibility which they had hitherto maintained. They were thus compelled to disclose those movements about which, neither before nor since, have we had any opportunity of learning.

With eyes full of astonishment, men watched those vast volumes of Krakatoa dust start on a tremendous journey. Westward the dust of Krakatoa took its way. Of course, every one knows the so-called trade-winds on our earth's surface, which blow steadily in fixed directions and which are of such service to the mariner; but there is yet another constant wind. We cannot call it a trade-wind, for it never has rendered and never will render any service to navigation. It was first disclosed by Krakatoa. Before the occurrence of that eruption no one had the slightest suspicion that far up aloft, twenty miles over our heads, a mighty tempest is incessantly hurrying with a speed much greater than that of the awful hurricane which once laid so large a part of Calcutta on the ground and slew so many of its inhabitants. Fortunately for humanity, this new trade-wind does not come within less than twenty miles of the earth's surface. We are thus preserved from the fearful destruction that its unintermittent blasts would produce—blasts against which no tree could stand and which would, in ten minutes, do as much damage to a city as would the most violent earthquake. When this great wind had become charged with the dust of Krakatoa, then, for the first and, I may add, for the only time, it stood revealed to human vision. Then it was seen that this wind circled round the earth in the vicinity of the equator and completed its circuit in about thirteen days.

VOLCANOES

EONS ago the earth on which we live was a huge mass of "fire mist." Astronomers tell us that today in the heavens we can see vast nebula, suggesting what the earth was once. Gradually the surface of the "fire mist" cooled and hardened, but the interior is still intensely hot. Whether it is solid, liquid, or viscous we do not know. This heat, raging miles below the surface, at times escapes through the hard crust by vents or volcanoes.

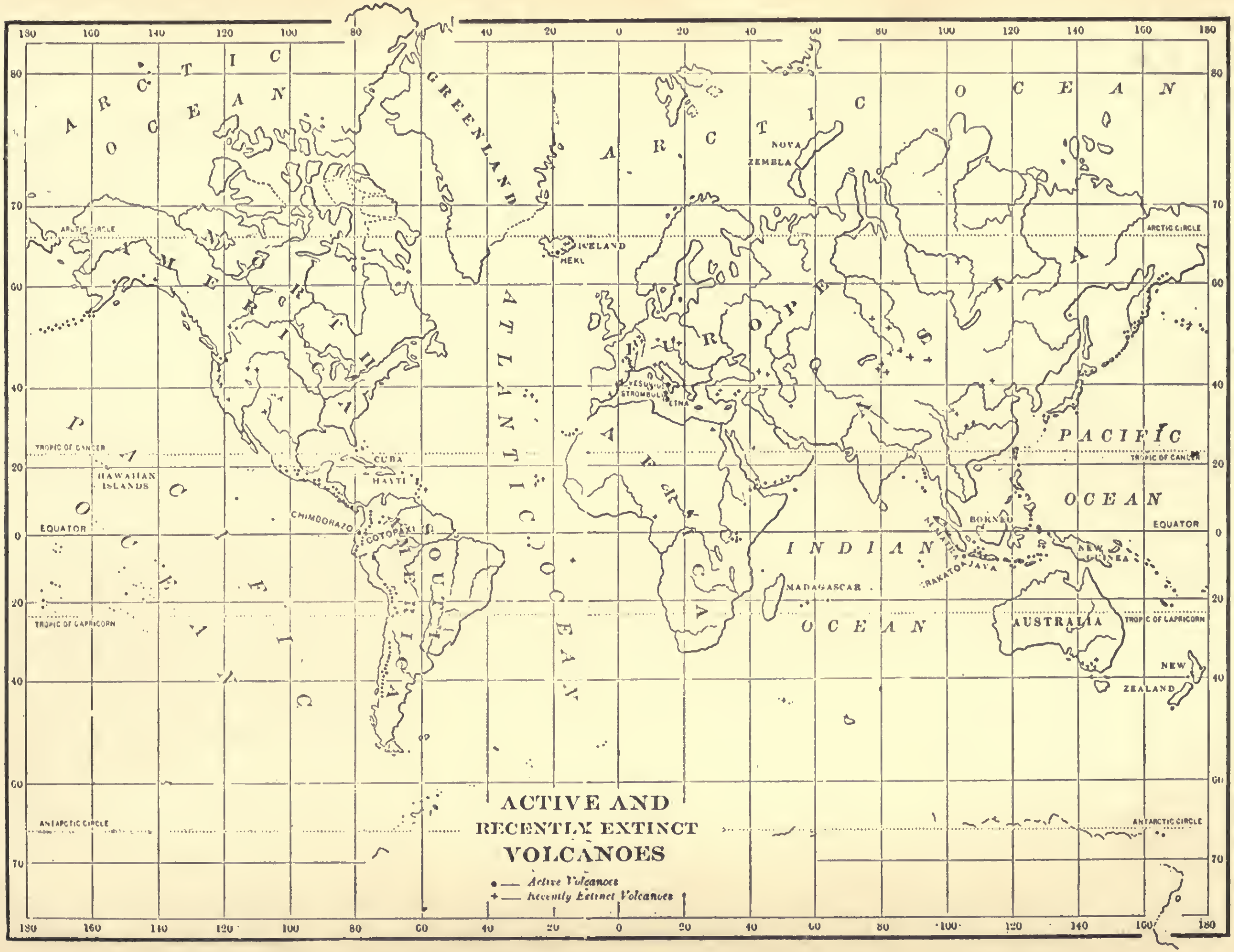
There are from 300 to 360 volcanoes on the globe. This estimate includes merely live volcanoes and volcanoes which within recent times have been in action. If we should count the many mountains scattered over the earth which show today signs of volcanic action in more remote past the estimate would have to be increased by many hundreds.

Volcanoes would seem to be arranged with more or less symmetry in belts circling the great oceans. A ring of fire surrounds the Pacific. Starting at the South Shetland Islands, several hundred miles south of Cape Horn, a belt of volcanoes extends up the west coast of South America, Central America, and North America; from Alaska it crosses the Pacific along the Aleutian Islands to Kamchatka; thence it follows the east edge of the Pacific through the Kurile Islands, Japan, Formosa, the Philippines, the Moluccas, the Solomon Islands, the North Hebrides, New Zealand, and finally ends in Mounts Terror and Erebus, on the Antarctic Continent. The volcanoes forming this great belt are in places ranged in chains, as along the west coast of Central America and in the Aleutian Islands; elsewhere they are separated by long distances, but nevertheless they would seem to have some connection with each other. Sometimes the line of volcanoes surrounding the Pacific is very narrow, as in Central America, and then again it broadens hundreds of miles, as in the western United States, where extinct volcanoes on the east edge of the belt are hundreds of miles from the ocean and distant from each other.

Within this great Pacific circle of volcanoes, twenty-five thousand miles in length, are many volcanic islands: the Ladrones, the Hawaiian Islands, with the famous Mauna Loa; the Galapagos, the Samoan Islands, as well as the Tonga and Fiji Archipelagoes, and many smaller groups. The coral islands may be also classed as volcanic, as they rest in great part on volcanic foundations.

Eastward from the circle around the Pacific, a branch belt extends through Sumatra and Java. On the broken isthmus which ages ago joined Asia and Australia are over one hundred volcanoes, many of which are constantly belching forth mud, lava, or ashes. This is the great focus of volcanic action of the earth.

Round nearly three sides of the Atlantic basin volcanic districts are scattered with some apparent symmetry. In the far north Hekla and nearly one score others separate the Atlantic from the Arctic Ocean. Stretching



Sketch Map of the World Showing General Distribution of Volcanoes

From "Volcanoes of North America," by Israel C. Russell (The Macmillan Co.)

from Iceland, from north to south an irregular submerged ridge bears the volcanic mountains of the Azores, the Cape Verde Islands, Ascension, St. Helena, and Tristan da Cunha. On the west edge of the Atlantic are the volcanoes of the West Indies; but north or south of the Antilles there is not a single volcano on the east coast of America. The volcanic belt of the Mediterranean shore is prolonged to the mountains of Armenia and western Arabia. There are said to be some volcanoes in Tibet and Manchuria, but the explorer has not yet located them.

Elisée Reclus has drawn attention to the fact that the great centers of volcanic action in the western and eastern hemispheres are at exactly opposite ends of the globe—are at antipodes to each other—and that these centers of activity are near the poles of flattening. They also flank, one on the west and one on the east, the immense circle around the Pacific.

Volcanoes may be roughly described as of two types—the expulsive and the explosive. Of the first, Hekla, in Iceland, Stromboli, and Mauna Loa in the Hawaiian Islands, are good examples. They pour forth masses of lava which flows like molasses. Of the second type are Vesuvius, Mont Pelée, the volcanoes of the West Indies, and those of the Andes and of Mexico; these eject the material andesite, and are more explosive than those ejecting the ropy lavas.

CAUSES OF VOLCANIC ACTION

Theories abound as to the cause of volcanic action, but of actual causes we know little. Science has no X rays to pierce into the bowels of the earth.

Lafcadio Hearn, in one of his interesting sketches of the French West Indies, published some years ago, tells the story of perhaps the only man who ever descended into the earth while it quaked. It seems that during a certain convulsion that shook and rent a certain island of the West Indies one man was thrown far down a fissure. He was unharmed, but his position, as he tumbled far down in the fissure, was not such as to inspire hope or a scientific study of what had happened or was happening. After some time passed there in the bowels of the earth, another convulsion shook and rent the ground. It tossed him up and up and out of the fissure and landed him unharmed on solid and firm ground; but when asked how it had all happened, the process of all this tossing, he could not explain. Science had lost its one chance of learning by personal observation what is happening beneath us.

Perhaps the most probable explanation of explosive eruptions of volcanoes is as follows:

The rocks deep beneath the surface are kept moist by the water that slowly seeps through. Probably the rocks contain from 3 to 20 per cent of water. The heat of the molten mass beneath the rocks gradually generates steam, and as time goes on more and more steam is generated. The pressure of this steam is constantly increasing until a time comes when the weight above can not hold in the expanding force of the steam. Like a boiler, the whole mass explodes with terrific fury. An earthquake may open a fissure which, by letting down water rapidly, will hasten the explosion; but it is doubtful if an earthquake can do more than this. Water entering by a fissure could hardly invade the vast area upheaved by an explosive eruption.

The Guatemalan earthquake of April probably timed the explosion of Mont Pelée and La Soufrière. It was the last straw; it brought the last ounce of pressure—one ounce more than the boiler could bear. The local earthquakes in Martinique and St. Vincent were the ruptures and tremors caused by the fettered steam.

Two other factors may assist this process: The shrinking of the earth, which allows the molten mass to rise through fissures and generate steam more rapidly, and the change of load at the surface, caused by deposition or degradation, which thus disturbs the law of equilibrium.

Of eruptions in general Professor Russell says:

"The cause of the rise of the molten rock in a volcano is still a matter of discussion. Certain geologists contend that steam is the sole motive power, while others consider that the lava is forced to the surface owing to pressure on the reservoir from which it comes. The view perhaps most favorably entertained at present in reference to the general nature of volcanic eruptions is that the rigid outer portion of the earth becomes fractured, owing principally to movements resulting from the shrinking of the cooling inner mass, and that the intensely hot material reached by the fissures, previously solid owing to pressure, becomes liquid when pressure is relieved, and is forced to the surface. As the molten material rises, it invades the water-charged rocks near the surface and acquires steam or the gases resulting from the decomposition of water, and a new force is added, which produces the most conspicuous and at times the most terrible phenomena accompanying eruptions.

"The recent volcanic outbreaks on Martinique and St. Vincent were eruptions of the explosive type The volcanoes have been dormant for years, and the lava in the summit portion of their conduits was cold and hard. Movements in the earth's crust caused a fresh ascent of lava from deep below the surface, the molten material came in contact with water in the rocks it invaded, and steam explosions resulted.

"These explosions were similar to what would happen if water should be poured on a mass of molten slag such as comes from an iron furnace."

SOME ERUPTIONS OF THE PAST

Prof. William M. Davis and Mr. William H. Snyder, in their excellent "Physical Geography" (Ginn & Co.), give a number of interesting instances of volcanic eruptions. I quote the following:

"Monte Nuovo (New Mountain) is a small volcano that was formed on the north side of the Gulf of Naples, in Italy, in 1538. Earthquakes occurred thereabouts for two years before the eruption, when in a week's time a cone was built up 440 feet high, half a mile in diameter at the base, and with a crater over 400 feet deep. Masses of lava 'as large as an ox' were shot into the air by the bursting of great bubbles of gas or steam that ascended through the lava in the vent. Finer ashes fell over the country for several miles around. The people of the neighboring villages fled in terror from their homes.

"A great eruption took place in Mexico in 1750, when the volcano Jorullo (pronounced Ho-rul-yo) was built on the central plateau, burying fertile fields of sugar cane and indigo. The outburst was preceded by earthquakes; the eruption continued half a year, building six cones and pouring out extensive lava flows. The highest cone, Jorullo, rose 700 feet above the plateau. The flows retained a perceptible heat for over 20 years.

"Many examples might be given of marine eruptions. In 1867 a shoal was discovered among the Tonga Islands of the Pacific (latitude 20° 20′ south, longitude 175° 20′ west), the surrounding sea floor being about 1,000 fathoms deep. In 1877 smoke was seen ascending from the sea surface over the shoals. In October, 1885, an island had been formed two miles long and 200 feet high. At this time a terrific eruption was in progress, enormous clouds of constantly changing form rising over the island. The shocks of the explosion were felt on neighboring islands, and the sound was heard 200 miles away. As the island consisted chiefly of ashes, it has since then been rapidly consumed by the waves, and will soon disappear unless new eruptions occur.

"In northern California there is a cinder cone of remarkably perfect form and certainly of recent date, although there is no record of its eruption. The cone, built of loose ashes, is 2,000 feet in diameter at its base, and rises 640 feet to a circular rim enclosing a crater 240 feet deep. It is perfectly barren. Although of moderate height, its ascent is difficult, as the ashes slide under a man's weight. A stream of lava emerges near the base of the cone, and, flowing westward into a neighboring valley, forms a large field a mile wide and nearly three miles long. The surface of the field is so covered with great clinkery blocks of lava as to be almost impassable. It is still unweathered and barren. The edge of the field is a steep clinkery slope 100 feet high. It obstructs a stream from the south, which forms Snag Lake, so called from the dead trees still standing in it. The lake outlet runs north along the west edge of the lava. On all sides the surface of the country is covered with a layer of volcanic ashes and dust, six or more feet deep near the cone, thinner and finer farther away, yet recognizable at a distance of eight miles. From the size of trees growing on the ashes, it is estimated that the cinder cone was built about 200 years ago. The lava flow is younger, but none of the Indians or early settlers thereabouts (1845) observed its eruption."

G. H. G.

MAGNETIC DISTURBANCE CAUSED BY THE EXPLOSION OF MONT PELÉE

IN explosive violence the eruption of Mont Pelée was to Krakatoa but the bursting of a bubble. Krakatoa was heard distinctly 3,000 miles away; the sound of Mont Pelée penetrated only 200. Krakatoa sent its dust round the globe; the dust of Mont Pelée was carried less than 300 miles. But in one very important respect, the electrical phenomena accompanying the explosion, Mont Pelée apparently surpassed Krakatoa; *for the first time in the history of volcanic eruptions, so powerful electro-magnetic waves were shot out by a bursting volcano that magnetic needles 2,000 and 5,500 miles away were disturbed for many hours.*

Mr. O. H. Tittmann, Superintendent of the U. S. Coast and Geodetic Survey, reports that the magnetic needles at the Coast Survey magnetic observatories at Cheltenham, Maryland, at Baldwin, Kansas, and also in the Hawaiian Islands, were disturbed on the morning of May 8 at the time of the volcanic explosion at Pelée. The needles are very delicately suspended, and register automatically by photographic means the minutest variation in the direction and intensity of the earth's magnetic force. The magnetic disturbance began at the Cheltenham observatory at a time corresponding to 7.53, St. Pierre local mean time, and at the Baldwin observatory 7.55, St. Pierre time. Reports from St. Pierre state that the explosion of Mont Pelée occurred a few minutes before 8 o'clock in the morning. A clock in St. Pierre was stopped at 7.50 a. m. The magnetic disturbance was thus almost instantaneously recorded at the Survey observatories. The needles were disturbed again on May 20, at the time of the second eruption of the mountain.

The disturbance of the magnetic needles was plainly due to magnetic effects, and was in no sense caused by purely mechanical vibrations. *It is the first instance that magnetic effects caused by eruptions of distant volcanoes have ever been recorded at magnetic observatories.* Mechanical vibrations of magnetic needles caused by earthquakes have been previously noted. For instance, the Guatemalan earthquake on April 18, 1902, caused a distinct mechanical vibration of the magnetic needles for at least one-half an hour, but no magnetic disturbance was registered. The distinct magnetic effect of the morning of May 8 pulled the magnetic needles aside from their usual direction for many hours.

Dr. L. A. Bauer, head of the magnetic work of the Survey, has not yet received information from the observatory at Sitka whether any magnetic disturbance was registered at this point at the same time, nor has he received information from foreign observatories. Until such information is received, of course we cannot state definitely that the remarkable magnetic disturbances registered on the mornings of May 8 and of May 20 at Cheltenham and Baldwin were due to the eruptions in the West Indies, but the very remarkable coincidence in time makes this conclusion probable.

THE NATIONAL GEOGRAPHIC SOCIETY EXPEDITION IN THE WEST INDIES

On their arrival at Martinique the National Geographic Society party separated. Prof. Robert T. Hill remained in Martinique to examine Mont Pelée, while Prof. Israel C. Russell and Mr. C. E. Borchgrevink proceeded to St. Vincent to investigate conditions on that island. The expedition, having been authorized to enlarge their party, associated with them Dr. Thomas A. Jaggar, of Harvard University; Mr. George C. Curtis, of Cambridge, and Dr. Angelo Heilprin, of the Board of Managers of the National Geographic Society (President of the Philadelphia Geographical Society), who arrived at Martinique several days after the other scientists.

WORK OF PROFESSOR HILL

Mr. Hill embarked on a steamer and examined the coast as far north as Macouba Point, the north end of the island, making frequent landings. After landing at Le Precheur, a little village five miles north of St. Pierre, he walked through an area of active volcanism to the devastated city. Mr. Hill, according to the Associated Press dispatches from Fort de France, was the first man to set foot in the area of craters, fissures, and fumaroles. During this trip along the coast, in addition to his work of investigation, Mr. Hill rescued in his steamer many poor persons of Le Precheur, who had been tempted back to their homes by the temporary lull of Mont Pelée and had since found themselves in great danger.

On his return to Fort de France he issued a brief statement as to his observations which may be published in advance of his detailed report to the National Geographic Society, which will be printed in this Magazine.

"The zone of the catastrophe in Martinique forms an elongated oval, containing on land about eight square miles of destruction. This oval is partly over the sea. The land part is bounded by lines running from Le Precheur to the peak of Mont Pelée, thence curving around to Carbet. There were three well-marked zones :

"First. A center of annihilation, in which all life, vegetable and animal, was utterly destroyed. The greater northern part of St. Pierre was in this zone.

"Second. A zone of singeing, blistering flame, which also was fatal to all life, killing all men and animals, burning the leaves on the trees, and scorching, but not utterly destroying, the trees themselves.

"Third. A large outer, non-destructive zone of ashes, wherein some vegetation was injured.

"The focus of annihilation was the new crater, midway between the sea and the peak of Mont Pelée, where now exists a new area of active volcanism, with hundreds of fumaroles, or miniature volcanoes.

"The new crater is now vomiting black, hot mud, which is falling into the sea. Both craters, the old and new, are active. Mushroom-shaped steam explosions constantly ascend from the old crater, while heavy ash-laden clouds float horizontally from the new crater. The old ejects steam, smoke, mud, pumice, and lapilli, but no molten lava.

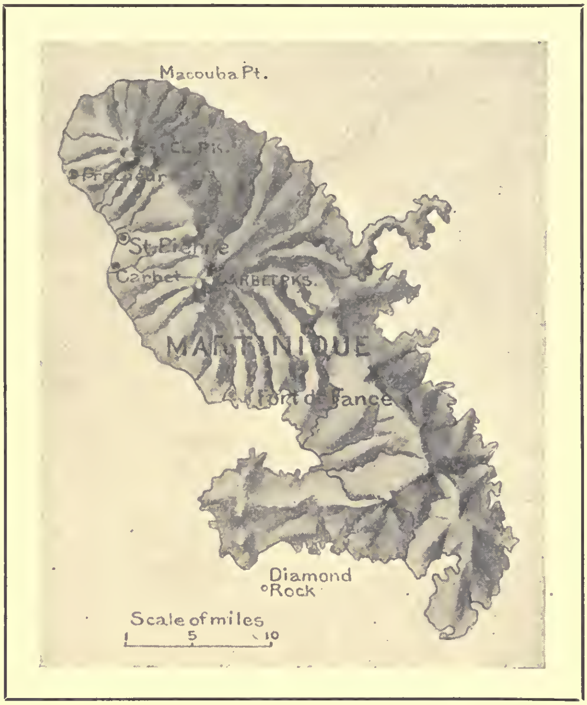
"The salient topography of the region is unaltered. The destruction of St. Pierre was due to the new crater. The explosion had great superficial force, acting in radial directions, as is evidenced by the dismounting and carrying for yards the guns in the battery on the hill south of St. Pierre and the statue of the Virgin in the same locality, and also by the condition of the ruined houses in St. Pierre.

"According to the testimony of some persons, there was an accompanying flame. Others think the incandescent cinders and the force of their ejection were sufficient to cause the destruction. This must be investigated. I am now following the nature of this hill."

On Monday, May 26, Mr. Hill started on horseback from Fort de France for Morne Rouge and Mont Pelée. He reached Morne Rouge safely Tuesday, where he succeeded in getting a number of photographs. A close approach to Mont Pelée was impossible, so he started back in a southerly direction. During the two nights he was camping out he made some important observations of volcanic action, and on his return issued the following statement :

"My attempt to examine the crater of Mont Pelée has been futile. I succeeded, however, in getting very close to Morne Rouge. At 7 o'clock on Monday evening I witnessed from a point near the ruins of St. Pierre a frightful explosion from Mont Pelée, and noted the accompanying phenomena. While these eruptions continue no sane man should attempt an ascent to the crater of the volcano. Following the salvos of detonations from the mountain gigantic mushroom-shaped columns of smoke and cinders ascended into the clear, starlit sky, and then spread in a vast black sheet to the south and directly over my head. Through this sheet, which extended a distance of 10 miles from the crater, vivid and awful lightning-like bolts flashed with alarming frequency. They followed distinct paths of ignition, but were different from lightning, in that the bolts were horizontal and not perpendicular. This is indisputable evidence of the explosive oxidation of the gases after they left the crater. This is a most important observation, and it explains in part the awful catastrophe. This phenomenon is entirely new in volcanic history.

"I took many photographs, but do not hesitate to acknowledge that I was terrified ; but I was not the only person



Sketch Map of Martinique Showing Mountainous Character of the Island

Diamond Rock is reported by passing vessels to be smoking

so frightened. Two newspaper correspondents who were close to Morne Rouge some hours before me became scared, ran three miles down the mountain, and hastened into Fort de France.

"Nearly all the phenomena of these volcanic outbreaks are new to science, and many of them have not yet been explained. The volcano is still intensely active, and I cannot make any predictions as to what it will do."

THE ASCENT OF MONT PELÉE BY PROF. ANGELO HEILPRIN

Associated Press dispatches from Martinique, under date of May 31, announced that Professor Heilprin had succeeded in climbing to the top of the crater of Mont Pelée. The dispatch is quoted as follows:

"The National Geographic Society has scored a great triumph through its representative here, Prof. Angelo Heilprin, who this morning with three guides ascended to the top of the crater on the summit of Mont Pelée. Professor Heilprin is also president of the Philadelphia Geographical Society.

"The expedition left Fort de France last Thursday, May 29, at noon. Friday was spent in studying the newly formed craters on the north flank of the mountain. Saturday morning Professor Heilprin determined to attempt the ascent to the top of the crater, and with this purpose in view he set out at five o'clock.

"The volcano was very active, but amid a thousand dangers Professor Heilprin reached the summit and looked down into the huge crater. Here he spent some time in taking careful observations. He saw a huge cinder cone in the center of the crater. The opening of the crater itself is a vast crevice 500 feet long and 150 feet wide.

"While Professor Heilprin was on the summit of the volcano several violent explosions of steam and cinder-laden vapor took place, and again and again his life was in danger. Ashes fell about him in such quantities at times as to completely obscure his vision. One particularly violent explosion of mud covered the Professor from head to foot with the hideous viscid and semi-solid matter. He still persisted in his study and observations, however, and twice more was showered with mud. He learned, as had been suspected, that there were three separate vents through which steam issued.

"Professor Heilprin's journey down the side of the mountain was fully as perilous as the ascent. Mont Pelée seemed to resent the intrusion of a puny human being into her most awful precincts, and belched out huge volumes of steam, ashes, and boiling hot mud.

"The Professor made the important discovery that the crater at the head of the River Fallaise has synchronous eruptions with the crater at the summit of the volcano, and that it ejects precisely the same matter at such times."

ASCENT OF MOUNT SOUFRIÈRE

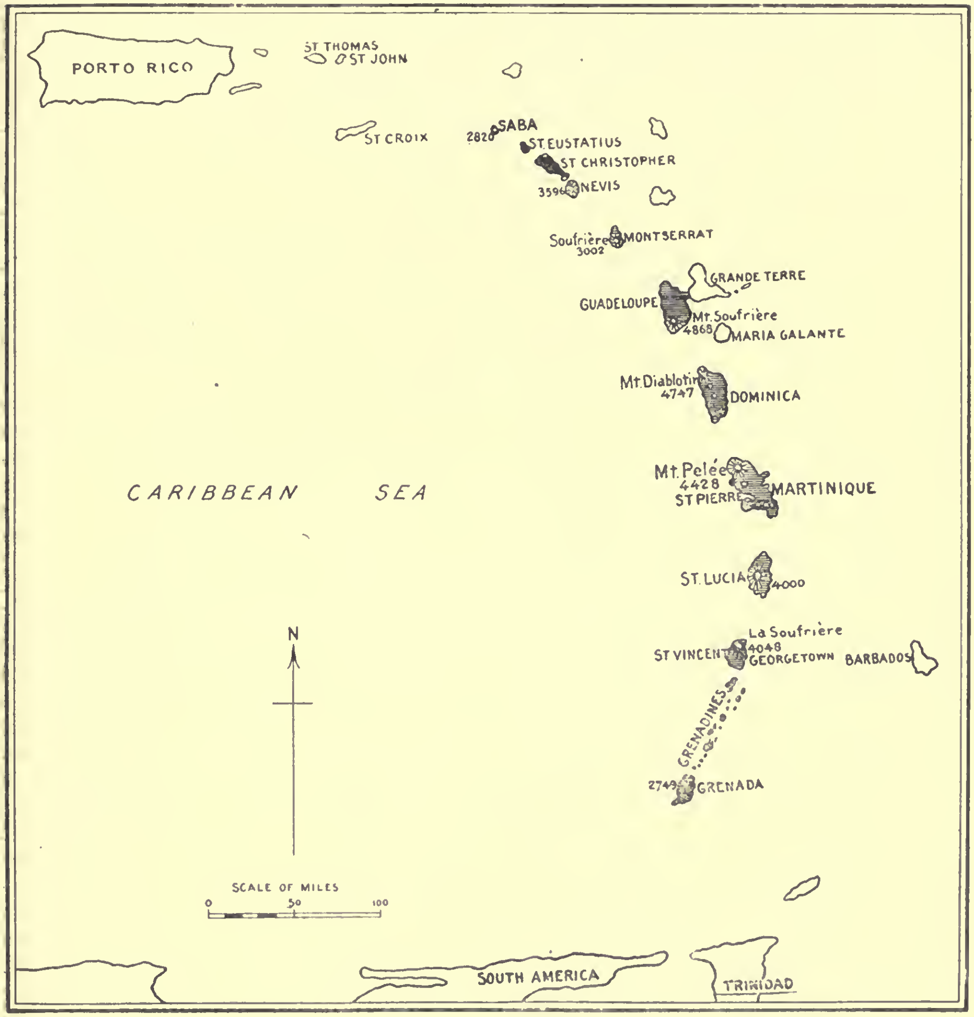
On May 31 a party consisting of Professor Jaggar, of Harvard University; Dr. Hovey, of the American Museum of Natural History of New York, and Mr. George C. Curtis ascended to the summit of Soufrière from the western side. Messrs. Jaggar and Curtis are working under the auspices of the National Geographic Society. Mr. Hovey is also a member of the Society, but represented the American Museum of Natural History. The cabled report of their achievement is as follows:

"The ascent was exceedingly difficult, owing to the mud that covered the mountain side, but the ground was cold. After a tiresome scramble up the slippery hill, the rim of the old crater was reached about midday. There was no trace whatever of vegetation, but there had been no change in the topographical outlines of the mountain on that side, and the old crater retained its tragic beauty. The great mass of water that formerly lay serenely about 500 feet below the rim of the crater had disappeared, and the crater appeared to be a dreadful chasm over 2,000 feet deep. With the aid of a glass water was made out at the bottom of this abyss.

"The party did not venture across the summit of the Soufrière to inspect the new crater, which was then emitting a little vapor, for the ground in that direction looked to be dangerous.

"Apparently the ridge of the mountain, called 'The Saddle,' was intact, although the old crater seemed of larger circumference than before the recent eruption. At the western base of the Soufrière a subsidence of a depth of 100 feet occurred for an area of a square mile. The bank of volcanic dust that prevents the sea encroaching farther inland at Wallibou is being gradually washed away. The lava beds on the eastern side of the Soufrière continue to emit steam, despite the protracted and heavy rainfall that has occurred. The eruption, the scientists say, was obviously more violent on the eastern side of the mountain, where the new crater is located, than on the western side."

VOLCANIC ISLANDS OF WEST INDIES



Map Showing the Volcanic Islands of the West Indies

The islands of volcanic origin, those which have been thrust above the sea by plutonic energy, are shaded. The others are of oceanic origin, formed of the calcareous remains of marine life. By a strange freak of nature Guadeloupe unites the two formations, the eastern half of the island (Grande Terre) being of marine origin, while the western half, joined to the other by a narrow isthmus, is volcanic, like Martinique. With the exception of Barbados, the volcanic islands have been the more prosperous and important.

LAFCADIO HEARN ON THE ISLAND AND PEOPLE OF MARTINIQUE*

THE first attempt to colonize Martinique was abandoned almost as soon as begun, because the leaders of the expedition found the country "too rugged and too mountainous" and were "terrified by the prodigious number of serpents which covered its soil." Landing on June 25, 1635, Olive and Duplessis left the island after a few hours exploration, or, rather, observation, and made sail for Guadeloupe, according to the quaint and most veracious history of Père Dutertre, of the order of Friars-Preachers. (Martinique was settled by the French in 1665, and with the exception of 22 years, 1794–1816, when the English held it, has been a French colony ever since. It sends a senator and two deputies to the National Assembly at Paris.)

No description could give the reader a just idea of what Martinique is, configuratively, so well as the simple statement that, although less than fifty miles in extreme length, and less than twenty in average breadth, there are upward of *four hundred mountains* in this little island, or of what at least might be termed mountains elsewhere. These again are divided and interpeaked, and bear hillocks on their slopes, and the lowest hillock in Martinique is fifty meters high. Some of the peaks are said to be totally inaccessible; many more are so on one or two or even three sides. Ninety-one only of the principal mountains have been named.

MONT PELÉE

Is the great volcano dead? Nobody knows. Less than forty years ago it rained ashes over the roofs of St. Pierre; within twenty years it had uttered mutterings. For the moment it appears to be asleep, and the clouds have dripped into the cup of its highest crater until it has become a lake several hundreds of yards in circumference. The crater occupied by this lake, called L'ètang or the Pool, has never been active within human memory. There are others—difficult and dangerous to visit because opening on the side of a tremendous gorge—and it was one of these, no doubt, which has always been called La Souffrière, which rained ashes over the city in 1851.

The explosion was almost concomitant with the last of a series of earthquake shocks, which began in the middle of May and ended in the first week in August—all much more severe in Guadeloupe than in Martinique. In the village Au Prêcheur, lying at the foot of the western slope of Pelée, the people had been for some time complaining of an oppressive stench of sulphur, or, as the chemists declared it, sulphuretted hydrogen, when on the 4th of August much trepidation was caused by a long and appalling noise from the mountain, a noise compared by planters on the neighboring slopes to the hollow roaring made by a packet blowing off steam, but infinitely louder. These sounds continued through intervals until the following night, sometimes deepening into a rumble like thunder. At 11 p. m. the noise was terrible enough to fill all St. Pierre with alarm, and on the morning of the 6th the city presented an unwonted aspect, compared by Creoles who had lived abroad to the effect of a great hoar-frost.

A committee appointed to make an investigation and prepare an official report found that a number of rents had either been newly formed, or suddenly become active, in the flank of the mountain. These were all situated in the immense gorge sloping westward from that point now known as the Morne de la Croix. It was satisfactorily ascertained that the main force of the explosion had been exerted within a perimeter of about 1,000 yards; that various hot springs had suddenly gushed out, and—the temperature of the least warm being about 57 degrees Réaumur (116 degrees Fahrenheit)—that there was no change in the configuration of the mountain, and that the terrific sounds had been produced only by the violent outrush of vapor and ashes from some of the rents. In hope of allaying the general alarm, a Creole priest climbed the summit of the volcano and there planted the great cross which gives the height its name and still remains to commemorate the event.

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* From "Two Years in the French West Indies," Lafcadio Hearn, Harper & Bros.

ST. PIERRE

St. Pierre is the quaintest, queerest, and the prettiest withal among West Indian cities—all stone-built and stone-flagged, with very narrow streets, wooden or zinc awnings, and peaked roofs of red tile, pierced by gabled dormers. Most of the buildings are painted in a clear, yellow tone, which contrasts delightfully with the burning blue ribbon of tropical sky above, and no street is absolutely level; nearly all of them climb hills, descend into hollows, curve, twist, describe sudden angles. There is everywhere a loud murmur of running water, pouring through the deep gutters contrived between the paved thoroughfare and the absurd little sidewalks, varying in width from one to three feet. The architecture is that of the seventeenth century, and reminds one of the antiquated French quarter of New Orleans. All the tints, the forms, the vistas, would seem to have been especially selected or designed for aquarelle studies. The windows are frameless openings without glass; some have iron bars; all have heavy wooden shutters with movable slats, through which light and air can enter.

THE PEOPLE

Fantastic, astonishing—a population of the "Arabian Nights." It is many-colored, but the general dominant tint is yellow. . . . Straight as palms, and supple and tall, these colored women and men impress one powerfully by their dignified carriage and easy elegance of movement. All, or nearly all, are without shoes. . . . Perhaps the most novel impression of all is that produced by the singularity and brilliancy of certain of the women's costumes. Some of these fashions suggest the Orient; they offer beautiful audacities of color contrast, and the full-dress coiffure, above all, is most striking. It is an immense Madras handkerchief, which is folded about the head with admirable art, like a turban, one bright end, pushed through at the top in front, being left sticking up like a plume. Then this turban, always full of bright canary color, is fastened with golden brooches, one in front and one at either side. As for the remainder of the dress, it is simple enough—an embroidered, low-cut chemise with sleeves; a skirt or jupe, very long behind, but caught up and fastened in front below the breasts, so as to bring the hem everywhere to a level with the end of the long chemise, and, finally, a foulard or silken kerchief, thrown over the shoulders. These jupes and foulards, however, are exquisite in pattern and color—bright crimson, bright yellow, bright blue, bright green, lilac, violet, rose, sometimes mingled in plaidings or checkerings or stripings; black with orange, sky-blue with purple; and whatever be the colors of the costume, which vary astonishingly, the coiffure must be yellow—brilliant, flashing yellow. The turban is certain to have yellow stripes or yellow squares. To this display add the effect of costly and curious jewelry, immense earrings, each pendant being formed of five gold cylinders joined together, cylinders sometimes two inches long and an inch at least in circumference; a necklace of one or many rows of large, hollow gold beads, called *collier-choux*.

But few are thus richly attired; the greater number of the women, carrying burdens on their heads, peddling vegetables, cakes, fruit, ready-cooked food, from door to door, are very simply dressed in a single plain robe of vivid colors (*douillette*), reaching from neck to feet, and made with a train, but generally girded well up so as to sit close to the figure and leave the lower limbs partly bare and perfectly free. These women can walk all day long up and down hill in the hot sun, without shoes, carrying loads of from one hundred to one hundred and fifty pounds on their heads, and if their little stock sometimes fails to come up to the accustomed weight, stones are added to make it heavy enough. With the women the load is very seldom steadied with the hand. The head remains almost motionless, but the black, quick, piercing eyes flash into every window and doorway to watch for a customer's signal. These women also carry the produce across mountain from plantation to seaport.

GEOGRAPHIC NOTES

THE CARIBS

WHEN Columbus landed at Haiti on his first voyage he heard much of the war-like people to the south who ravaged the more peaceful natives of Haiti and the northern islands. But it was not until the end of 1493, on his second voyage of discovery, that he landed at Guadeloupe, the stronghold of the Caribs, and first beheld this cannibal race. Washington Irving, in his "Life and Voyages of Christopher Columbus," describes the horror of the Spaniards when they found human limbs suspended from the beams of the houses as if curing for provisions. "The head of a young man, recently killed, was yet bleeding. Some parts of his body were roasting before the fire; others boiling with the flesh of geese and parrots."

The whole archipelago, extending from Porto Rico to Tobago, was under the sway of the Caribs. They were a warlike and unyielding race, quite different from the feeble nations around them. Of the thousands of these fierce people who dominated the Caribbees four centuries ago, only a few hundred descendants remain. In the northern part of St. Vincent a few Caribs are still left, and in Dominica are a few others.

The Caribs were also found in Guiana and along the Lower Orinoco. Spain condemned them to slavery, but they were not much molested by her because of their fierce character. In later years the English and French fought long and bloody wars with them. St. Vincent became their last stronghold. In 1796 England transported 5,000 Caribs from St. Vincent to the island of Ruaton, whence many of them passed to Honduras and Nicaragua.

THE RUSSIAN TIBET EXPEDITION

IN the spring of 1899 the Russian Geographical Society sent an expedition to central Asia and Tibet under command of Captain P. K. Kozloff. The Czar had granted the money for the purpose. Captain Kozloff set out with a party of 38, including several scientists. During the years 1899, 1900, and 1901 Captain Kozloff was exploring the desert of Gobi, Mongolia, and Tibet. He returned to St. Petersburg in January, 1902. The *Geographical Journal* for May contains a detailed account of the very important results of the expedition, which Captain Kozloff summarizes as follows:

"We have thoroughly explored the Chinese or Mongolian Altai, the central Gobi, and that portion of inner Tibet which is known as 'Kam.' The Altai has been explored all along its northern and southern foot, and has been crossed several times. The desert of the Gobi was crossed along four different routes in the winter, provisions of ice or snow being taken during these crossings. In eastern Tsaidam, at the northern foot of Tibet, a depot of the collections and the provisions was organized, and the camels were left, the journey in Tibet being only possible with oxen. At this depot a meteorological station was organized, as had been recommended by the late General Tillo. Four men, under Sergeant Ivanoff, were left at the station, and the conduct of the meteorological observations was left to Muravioff, who had received the necessary preliminary training. The Tsaidam meteorological station has thus worked for fifteen months without interruption, the records of the instruments being taken thrice a day and once every three months every hour for twenty-four hours in succession. This was the first time that such work was done in central Asia, and the observations of the Tsaidam station will give a solid basis for calculating out altitudes in Tibet. It was also the first time that a canvas boat was used for the exploration of lakes in central Asia, their depths and their flora and fauna.

"We brought back with us: (1) about 8,000 miles of survey; (2) the positions of forty localities determined astronomically; (3) geographical, historical, and ethnographical, as also commercial information about the regions visited; (4) more than 400 photographs; (5) meteorological observations which were made regularly every day, and (6) rich natural history collections—that is, about 1,200 geological specimens, nearly 1,400 species of plants (over 30,000 specimens), and the following zoölogical specimens: 300 skins of mammals, 10 skeletons, 1,500 birds, 500 fishes and reptiles, and 30,000 insects. All these collections have already reached St. Petersburg in good order, have been arranged, and are already in the hands of specialists and different bodies."

TOPOGRAPHIC SURVEY OF THE UNITED STATES

THE extent to which the topographic mapping of the United States has been conducted by the United States Geological Survey, including the progress made during the fiscal year ending June 30, 1901, appears in a comprehensive statement by Director Charles D. Walcott in his Twenty-second Annual Report, which has just been issued. Since its organization, the United States Geological Survey has been engaged in making a topographic survey and map of the United States. The unit of survey is a quadrangle 15′, 30′, or 1° in extent each way. The unit of publication is an atlas sheet 16½ inches wide by 20 inches high, and each sheet is a topographic map of one of the above areas. The maps are engraved on copper and printed from stone, in three colors. The cultural features, such as roads, railroads, cities, towns, etc., as well as all lettering, are in black; all water features are printed in blue, while the hill features are shown by brown contour lines. Maps of limited areas, economically important, also maps of the larger cities and their suburban districts, are sometimes published which are not in conformity with the general scheme outlined above. These are known as *special maps*. By act of Congress, the maps are disposed of by sale, those of standard size at 5 cents a sheet; for 100 or more in one order the maps of standard size are listed at 2 cents each.

The Director's report shows that, during the year which it covers, 35,123 square miles were covered by detailed topographic mapping, distributed through thirty-two states and territories, and that 12,407 miles of level were run and 1,338 permanent bench marks were established, these bench marks being iron posts, bronze or aluminum tablets, or copper or aluminum plugs. In connection with this work, primary azimuth observations were made at four triangulation stations, 37 meridian lines were established, 271 triangulation stations were occupied, and 2,088 miles of primary traverse were run. In connection with the surveys in Alaska, about 6,500 square miles were mapped topographically, thus opening up many new regions, some of which were before entirely unknown. In addition to the mapping, about 150 linear miles of stadia traverse and 274 linear miles of reconnaissance traverse were run. With reference to the surveys of the forest reserves, 23 miles boundary of the Black Hills Reserve, and 109 miles of the boundary of the Bighorn Reserve were surveyed and marked. The completion of the topographic work of the year 1900–1901 makes a total, with that previously done, of 866,847 square miles of the United States which have been fully surveyed and mapped, or 29 per cent of the entire area of the country.

For purposes of administration the territory of the country has been divided into five sections—the Forest Reserves section, Mr. Henry Gannett, geographer in charge; the Atlantic section, the work of which is controlled by Mr. H. M. Wilson, geographer in charge; the central section, with Mr. John H. Renshawe, geographer in charge; the Rocky Mountain section, with Mr. E. M. Douglas, geographer in charge, and the Pacific section, under the direction of Mr. Richard U. Goode, geographer.

Within the last few years one of the features of the work of the topographic branch of the Geological Survey has been the coöperative arrangements made between the Survey and various states, by which certain sums were appropriated by the state legislatures, which were duplicated by the Federal bureau, the latter also furnishing the engineers for the accomplishment of the work. Arrangements of this character were of advantage to the states, as they insured the publication of detailed topographic maps much more rapidly than would otherwise have been the case, the mapping being promptly followed by investigations of mineral water and timber resources. Coöperative arrangements of this nature, as noted by the report, were made with five states during the year, $19,500 being allotted by the State Engineer and Surveyor of New York; $18,000 by the State Survey Commission of Pennsylvania; $2,500 by the State Survey Commission of Maine; $5,000 by the State Geologist of Maryland, and $1,000 by the State Geologist of Alabama. The above amounts were all appropriations made by the states mentioned for coöperation with the Geological Survey. In addition, the state legislature of Ohio appropriated $25,000 to be available February 15, 1901; but no detailed mapping was commenced prior to the beginning of the usual field season.

NATIONAL GEOGRAPHIC SOCIETY NOTES

ISRAEL C. RUSSELL, Professor of Geology in the University of Michigan, Ann Arbor, has been elected a member of the Board of Managers of the National Geographic Society, to fill the vacancy caused by the resignation of Prof. W. B. Powell. Professor Russell headed the expeditions sent by the Society some years ago to explore and ascend Mount St. Elias. He is the author of "Lakes of North America," "Glaciers of North America," "Volcanoes of North America," and many pamphlets and government reports.

Dr. Israel C. Russell

Member of the National Geographic Society Expedition to the West Indies

Gen. A. W. Greely, U. S. Army, has accepted the chairmanship of the Committee on the Eighth International Geographical Congress, which will meet in 1904, in Washington, under the auspices of the National Geographic Society. General Greely represented the National Geographic Society and the United States Government at the Geographical Congress at Berlin in 1899, and at the Congress in London in 1895.

In addition to the three members of the National Geographic Society Expedition, Messrs. Russell, Hill, and Borchgrevink, there sailed on the *Dixie* for Martinique May 14 six other members of the National Geographic Society: Mr. George Kennan, the noted traveler and author; Dr. E. O. Hovey, of the American Museum of Natural History; Prof. Thomas A. Jaggar, of Harvard University; Mr. George C. Curtis, of Boston, the well-known maker of land models; Mr. Robert Dunn, of New York, who has done considerable work among the Wrangell group of mountains, Alaska, and Mr. August F. Jaccaci, Art Editor of *McClure's Magazine.*

MOUNT BLACKBURN

TRAVELERS returning from Alaska have reported that Mount Blackburn, of the Wrangell group, in the southeastern part of the territory, was in active eruption in April. It is a lofty mountain, reaching to a height of 16,140 feet. Mr. Arthur C. Spencer, of the U. S. Geological Survey, who explored the mountain in 1900, states that at the time of his visit it could hardly have been called a volcano, extinct or alive, and he questions the report of its recent activity. Mount Blackburn is a rugged mass of limestone and various types of igneous rocks The lesser mountains around Blackburn are covered with volcanic material to a depth of several hundred feet, probably ejected from an ancient crater on Mount Blackburn. The top of the volcano had been worn away by erosion until it seemed highly improbable that it would ever come to life.

ST. VINCENT

THE little island of St. Vincent is 17 miles long and about 10 miles wide. On its area of 121 square miles is a population of nearly 50,000, who live for the most part on the southern half of the island. At one time St. Vincent was the scene of much prosperity and considerable enterprise, but the sugar industry which gave it success is almost dead. One writer, comparing the four most ideal islands of the Caribbees—Guadeloupe, Dominica, Martinique, and St. Vincent—says: "The first is grand and gloomy; the second is somber in its mountains, but breaks out into smiling tracts of cultivated land; the third combines the features of the first two and adds the element of a large and picturesque population, while St. Vincent has all the natural wonders and beauties of the other three and a certain air of delicate culture which is entirely its own."

The disaster of May, 1902, which destroyed 2,000 people on the island, is not the first that has befallen St. Vincent. Defoe has written a graphic description of a fearful eruption of the great crater in 1718.* In 1812 a great volcanic upheaval wrought fearful havoc, destroying thousands of lives. This eruption probably terminated the volcanic and seismic disturbances which for two years had been disturbing the region of the Caribbean Sea.

St. Vincent is a colony of Great Britain. Grenada, the Grenadines, Barbados, St. Lucia, Dominica, Montserrat, Nevis, and St. Christopher are also British property. Martinique and Guadeloupe fly the French flag, while Saba and St. Eustatius belong to the Dutch.

CHILE-ARGENTINA BOUNDARY DISPUTE

THE governments of Chile and Argentina have signed an agreement which will probably end the long-standing dispute between the two countries. The principal points of the agreement are: (1) a treaty of general arbitration to last ten years; the arbitrators shall be two foreign powers, of which Great Britain shall be one; (2) that each nation shall remain neutral in all questions now pending with other countries; (3) that the armaments of each republic shall be placed on an equal footing. Landmarks are to be placed on the boundary as it is determined by a technical commission appointed by the arbitrator.

TOPOGRAPHIC MAPS

AMONG the recent atlas sheets reissued by the United States Geological Survey is the Ellis, Kansas, sheet. The map represents a rectangular section about 27½ by 35 miles, just west of the center of the state, showing parts of Treco, Ellis, Rush, and Ness counties.

Another reprint issued by the Survey is the map known as the Huntersville sheet, which covers a portion of southeastern West Virginia near the state line, including the country adjacent to the towns of Huntersville and Addison.

FELLOWS OF THE NATIONAL GEOGRAPHIC SOCIETY

AT a regular meeting of the National Geographic Society, May 16, an important change in the by-laws of the Society was unanimously adopted. It was decided to institute a class of "fellows" in the Society. This class of "fellows" is to be strictly limited to persons actively engaged in geographic work and who have attained distinction for their achievements in geographic science. By vote of the Society the election of "fellows" is vested in the Board of Managers. No elections have yet been made, and none will be made before the fall of 1902.

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* Defoe's account of the eruption of 1718 was published in *Mist's Journal* on July 5, 1718. It was republished in the "Life and Newly Discovered Writings of Daniel Defoe," London, 1869, and in the New York *Evening Post* May 31, 1902.

GUSTAVE HERRLE

GUSTAVE HERRLE, whose death occurred in Washington, D. C., on April 16, 1902, exercised a notable influence in American geographical work. He was born in Wels, Austria, in 1843, and was educated in the Polytechnic School of Tuln for the career of a military engineer. In 1864 he joined his fortunes with those of Maximilian, Archduke of Austria, in the establishment of an empire in Mexico, and, in 1867, upon the fall of the Mexican Empire, he came to the United States, and was engaged for some years, under the direction of the late General Gilmore, in the construction of the harbor fortifications of New York.

In 1872 he became identified with the work of chart construction in the United States Hydrographic Office, and for many years invested his position at the head of the cartographic draftsmen of that office with a rare combination of knowledge and skill and diligence which, by enabling him to impress his character upon the marine hydrographic charts of the Navy Department, has served to elevate American cartography, and has made him a contributor of uncommon importance in the production of the independent resources of the people of the United States for conducting navigation beyond their own shores.

G. W. LITTLEHALES.

Crater Lake, Oregon.—Glittering snowfields and vast glaciers now cover the summits of the mighty volcanic mountains of the western United States—Mt. Shasta (14,350 feet), Mt. Rainier (14,525 feet), Mt. Hood (11,225 feet), and other noble peaks. One of the most remarkable of these extinct volcanoes is the well-known Mt. Mazama, in Oregon. The crater of Mt. Mazama is now occupied by a lake five to six miles in diameter. The lake is 6,239 feet above the sea, is 1,975 feet deep, and surrounded by almost vertical walls towering 900 to 2,200 feet. This is the only crater lake in the United States. An illustrated description of the lake, by J. S. Diller, was published in this Magazine, Vol. VIII, No. 2.

The Royal Geographical Society has founded a gold medal for geographical research, the Victoria medal, in honor of Queen Victoria, who was for many years patron of the society. The first award has been made to Mr. E. G. Ravenstein for his excellent work in cartography and in special recognition of his map of East Central Africa.

The Geographical Society of Philadelphia has awarded the Kane medal for this year to Lieut. Robert E. Peary for his achievements in Greenland in 1900. The medal was received by Mrs. Peary at the annual meeting of the Society, May 7.

GEOGRAPHIC LITERATURE

Finland: Its Public and Private Economy. By N. C. Fredricksen. 8vo, pp. xi + 306, with 5 maps. London: Edwin Arnold. 1902.

The table of contents of this book suggests a compendium of information concerning this little-known country, and between its covers much information is contained, but it is not of the sort which the average reader wants or expects. Such basic facts as area and population are conspicuous by their omission. Much is said in detail about the agricultural industry, but nothing which will enable the reader to measure its importance. Much space is devoted to forestry, but after reading this chapter, one has only a confused and indefinite idea of the extent and value of the Finnish forests. The same indefiniteness characterizes the chapter on the foreign trade of the country. There is vastly more information concerning Finland in four pages of the *Statesman's Year-book* than in this entire work.

The Earth's Beginning. By Sir Robert Stawell Ball. With four colored plates and numerous illustrations. Pp. 384. New York: D. Appleton & Co.

In his preface to the book Sir Robert Ball states that his aim has been to give "a popular exposition of that splendid branch of astronomy which treats of the evolution of the earth, the planets, and the sun from fire-mist." The author has been successful in his object and has written a book that will be widely and profitably read at the present time, when the whole world is so deeply interested in the facts of the earth. In clear and graphic description of abstruse scientific theories Sir Robert Ball is a master. Some of the chapter headings are: "The Fire-mist," "Nebulæ, Apparent and Real," "Earthquakes and Volcanoes," "The Unity of Material in the Heavens and the Earth."

The Statesman's Year-book for 1902. Edited by J. Scott Keltie, assisted by I. P. A. Renwick. With eight maps. Pp. 1332. New York and London: The Macmillan Company. $3, net.

The latest edition of this indispensable year-book contains much new data. Within the year censuses have been taken of the British Empire and of many countries. All the new information thus acquired has been included in the volume. A valuable feature of the Year-book for 1902 is a series of maps and charts showing the density of population of Europe in 1901, the comparative growth of population of countries and of cities during the nineteenth century, the Uganda Railway and projected railways in Africa, etc. One map, that of the region of the proposed Nicaragua Canal, may be rightly criticised for incompleteness, as it fails to show the volcanoes, extinct or alive, in the Nicaragua region.

A Geological Study of the Fox Islands, Maine. By Geo. O. Smith. Colby College Bulletin, vol. ii, no. 1, April, 1902. Paper, $0.50; cloth, $0.75.

Summer visitors to the coast of Maine will find Dr. Smith's little study of North Haven and Vinal Haven Islands an interesting companion to consult. On the islands they will find the seat of an ancient volcano, with its lavas and tuffs still well enough preserved to be recognizable. In the book they may learn how to unravel the history of the islands from the rocks, and may discover the cause of their peculiar and interesting topography. The text is accompanied by a geological map of the Fox Island group.

First Across the Continent—The story of the Exploring Expedition of Lewis and Clarke in 1803-4-5. By Noah Brooks. 8vo, pp. xii + 364, map and 24 cuts. New York: Chas. Scribner's Sons. 1901.

This is a popular narrative of the well-known expedition across the continent, which gave us our first authentic information concerning its western part. It is largely composed of extracts from the journal of the explorers, supplemented and tied together by the author. The story of this remarkable expedition, though often told, never loses its fresh interest and romance, and Mr. Brooks' book will be welcomed by thousands of readers.

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THE NATIONAL GEOGRAPHIC MAGAZINE

REPORT BY ROBERT T. HILL ON THE VOLCANIC DISTURBANCES IN THE WEST INDIES

WASHINGTON, D. C., *June 24, 1902.*

DR. ALEXANDER GRAHAM BELL,
President National Geographic Society.

DEAR SIR: I transmit herewith my report on my investigations of the recent volcanic eruptions of Mont Pelée, Island of Martinique. I had previously made two visits to the island and was somewhat familiar with its topography and geology. My researches consisted of ten days' study on the island, from May 21 to May 30, inclusive. Most of the time was devoted to studying the physiographic effects of the volcano, the nature of its eruptions and ejecta, and the procuring of evidence from eyewitnesses concerning the facts of the catastrophe. I traveled extensively over the surface and margins of the area of the disaster on foot and horseback and circumscribed the coast with boats.

During my stay I was placed under repeated obligations for courtesies extended by U. S. Consul Ayme, Captain McLean, of the U. S. cruiser *Cincinnati*; Lieutenant McCormick, commander of the U. S. tug *Potomac*; Admiral Servan and officials of the French fleet; Mr Ferdinand Clerc, the leading planter of the island, and innumerable members of the negro and colored peasantry, whose courtesy and hospitality were graciously extended on every occasion. Special thanks are due Captain Berry and all the officers and sailors of the *Dixie*, who by self-deprivation accommodated our party on their vessel. Thanks are also due Mr J. S. Diller and Dr George Steiger, of the U. S. Geological Survey, for their prompt petrographic examination and chemical analyses of the specimens collected, and for their prompt reports published elsewhere in this Magazine.

In the present article I have endeavored to present a technical statement of the actual events of the great eruption. The time has been too limited for me to thoroughly digest and interpret the data collected. Later I shall present some further remarks and my final conclusions on the phenomena in the Century Magazine for September. It is also but just to remark that the accompanying article does not pretend to be a complete or final presentation. I appreciate that my associates, Professors Russell and Jaggar, who accompanied the *Dixie*, and Professor Heilprin, who arrived on the island as I was leaving, all collected information and data equally as valuable as mine, and that they may have deductions of greater importance.

Very truly yours,
ROBERT T. HILL,
Geologist, U. S. Geological Survey.

Robert T. Hill C. E. Borchgrevink Israel C. Russell
Thomas A. Jaggar E. O. Hovey

On Board the *Dixie*

Messrs Hill and Russell contribute to this number their preliminary reports to the National Geographic Society. It seemed best that one of the geologists of the National Geographic Society expedition should remain in the region of volcanic disturbance. Dr Thomas A. Jaggar, who is professor of geology in Harvard University, was therefore commissioned by the Society to continue his researches, and his report will be published later in this Magazine. Lack of space prevents our publishing Mr Borchgrevink's report in this number. Dr E. O. Hovey, a member of the National Geographic Society, represented the American Museum of Natural History.

G. H. G.

THE DEPARTURE

THE Lord rained fire and brimstone and the smoke of the country went up as of a furnace.—Bible.

The present year seems to be one of unusual volcanic and seismic activity. In Russia, Mexico, Guatemala, the West Indian and Aleutian Islands disturbances of severity, accompanied by great loss of life, have taken place, while the volcanoes of Vesuvius and Hawaii are also displaying marked activity. It was reserved for two apparently quiescent and long-forgotten volcanoes in the West Indies, however, to give us an exhibition of sudden and deadly violence, and to awaken a world-wide interest in these phenomena.

The first news of the outburst of the Martinique volcano to reach the United States was a dispatch May 6 from St Thomas, West Indies, to the *New York Journal*, announcing that the flow of lava from the volcano Montagne Pelée, Island of Martinique, had begun, and on the previous Saturday, May 3, had completely destroyed the Guerin factory, situated two miles from St Pierre, the principal town of Martinique, and reporting that there was a rumor to the effect that 150 persons had disappeared.

On May 9 the frightful news followed, announcing that the beautiful city of St Pierre, with all its inhabitants, had been annihilated on the preceding day by a terrific volcanic outburst.

As horrible as are volcanic disasters, they are always exaggerated in the first reports, and many were loath to believe that 30,000 people had been swept into eternity at a single moment, as was described.

Sitting in my office, where at the time I was preparing a long-deferred report upon the geology of the Windward Islands for Professor Alexander Agassiz, to be published by Harvard University, the news was made known to me by a reporter of the *New York Herald*, who asked me to give him some information (published in the *Herald* of May 10) upon the geology of the islands and the volcanoes. From that moment until the sailing of the *Dixie*, at 9 p. m. on the night of May 14, when she sailed from the Brooklyn dock, I was besieged by reporters for information, and since that first news I have myself been in a continuous state of eruption from endeavoring to procure and give such information as within my power.

THE START

On Tuesday, May 13, the officers of the National Geographic Society requested me to accompany the *Dixie* relief expedition, which sailed at the hour previously stated. Without preparation I joined the ship, and on the morning of the 15th was well out to sea, headed for the scene of disaster.

We had hardly settled ourselves on board the man-of-war when we began to speculate concerning the conditions which we would find awaiting us at the island. Immediately following the news of the catastrophe at St Pierre the reports were full of accounts of many startling phenomena. Among these may be mentioned the rumors that the top of the mountain had blown away; that the island had decreased in area one-half; that the entire north coast had disappeared; that the sea bottom had sunk 1,000 feet; that the streams of lava were flowing, and that the configuration of the entire island had been changed. Finally, as we left New York, the afternoon papers printed rumors that Fort de France had been burned, so that for seven days we sailed in ignorance of the conditions awaiting us.

From all parts of the world also came notices of impossible accompanying phenomena. Volcanoes were found in Nebraska and upon the sedimentary islands of Alaska. Earthquakes were reported from Asia to South America; red sunsets seen in distant lands; floating bodies and débris picked up far from the scene of the disaster. Even recently it has been reported that the surface of Pennsylvania had caved in since the disaster, and that the enthusiastic crank who discovered this fact was coming to Washington to see if the national capital had not suffered a similar subsidence. Fortunately we found that most of these reports were founded upon imagination or over-enthusiasm, and upon their face are as apparently incredible as were the reports of two floating islands inhabited by hordes of monkeys and green parrots reported to have been seen on the Gulf by the facetious editor of a Washington paper.

It will be impossible for me in the accompanying paper to take up each rumor and dissect it specifically; but I shall endeavor to present every fact which has come under my observation or been recorded by me from the lips of authentic witnesses, leaving to the end the presentation of deductions concerning the immediate cause of the disaster.

GENERAL GEOGRAPHY OF THE WINDWARD ISLANDS

In order to fully understand the catastrophe it will be necessary to present a brief review of the geography and geology of the region.

Across the throat of the Caribbean extends a chain of islands (the Caribbees), which are really smouldering furnaces, with fires banked up, ever ready to break forth at some unexpected and inopportune moment. This group, commencing with Saba on the north, near our own Porto Rico, and ending with Grenada on the south, near Trinidad, consists of ancient ash (lapilli) heaps, piled up in times past by volcanic action. These old ash heaps have weathered into fertile soil, which, bathed by an undue share of moisture, has become covered with ripe growths of damp and mouldering vegetation. This same soil produces all the richest vegetable products of the Tropics.

In three previous papers I have given descriptions and classifications of the geologic, geographic, and political conditions of the West Indies. In the first of these, "The Geology and Physical Geography; study of a type of Antillean development based upon surveys made for Alexander Agassiz," * I endeavored to give every fact concerning the complicated geological structure of the many types of islands, together with the more or less complicated physiographic history of how they are made and the changes which they have undergone. In the second work, "Cuba and Porto Rico, with the Other Islands of the West Indies," * a popular geographic story of the islands, their resources and their people, was presented. The third article, entitled "The Broken Necklace," in the *Century Magazine* for April, 1901, endeavors to relate the unhappy conditions which have brought the islands into a state of economic ruin.

To those who first look at the map and have not considered their minute geology, the Lesser Antilles appear as the members of a kindred archipelago. The Virgin Islands at the north are Antillean, while all south of Grenada are South American in natural relations. Even after detaching their termini the remaining islands of the archipelago lying between the Anegada Passage and Tobago, constituting the Windward group, present almost as complicated composition. Some of the northern islands, such as Santa Cruz and St Bar-

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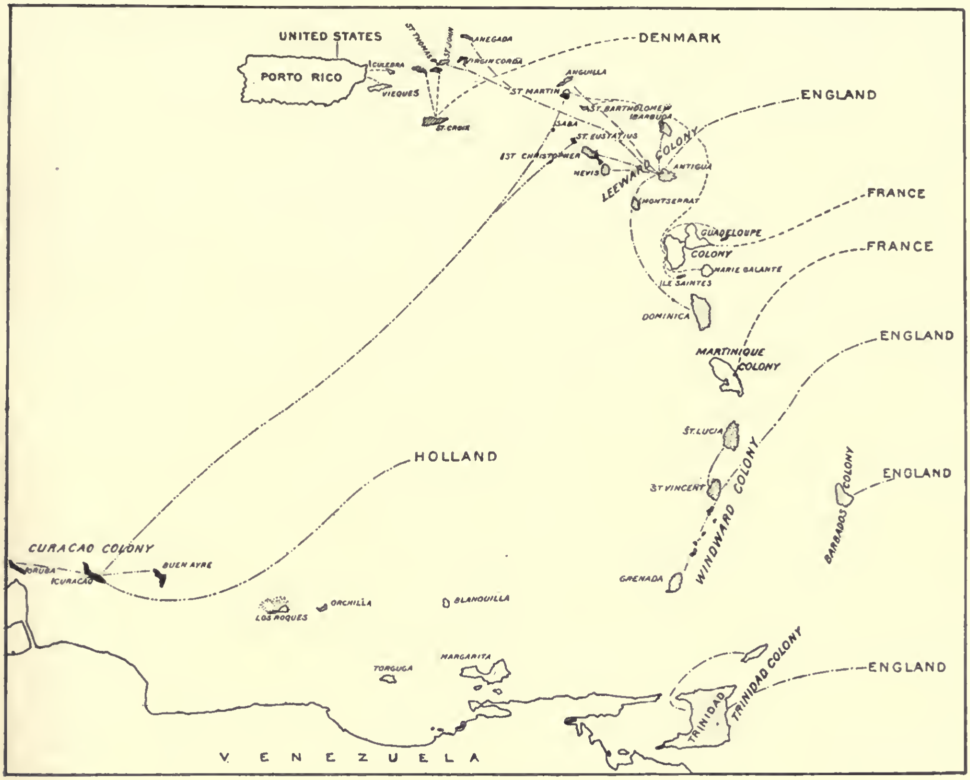
* Bulletin Museum of Comparative Zoölogy, Harvard College, parts v and vi, Sept., 1899.

* The Century Company, New York, 1898, second edition, 1900.



Political Map of Windward Islands

tholomew, are also Antillean in structure, and were it not for the deep Anegada Passage, which almost severs the latter from the submerged platform at the north end of the Windward Channel, they might probably be considered Antillean.

All the Windward Islands with the exception of Barbados probably have a base of volcanic rock, notably St Martins and Antigua of the outer chain. The Windward Islands constitute a unique and peculiar geologic province, the discussion of which, with their general phenomena, can now be briefly considered.

The islands of the chain, however, south of the Anegada Passage and north of Trinidad, constitute a different geologic type, which may be classed by composition into three general subtypes as follows: (1) Volcanic islands composed almost entirely of igneous material; (2) islands composed, at their surface at least, of organic oceanic sedimentary débris, and (3) compound islands, with a higher summit region of volcanic rocks of the first-mentioned class, with added areas or benches of sedimentary rocks. These three types are exemplified in Martinique, Barbuda, and Antigua.

WINDWARD GROUP

The Windward group is divisible into two parallel belts extending the length of the archipelago. The eastern belt, composed of the sedimentary and compound type, includes Sombrero, Dog, Anguilla, St Martin, St Bartholomew, Barbuda, Antigua, the Grande-Terre of Guadeloupe, Marie Galante, and Desirade.

The inner belt facing the Caribbean includes Saba, St Eustatius, St Christopher, Nevis, Monserrat, Basse-Terre, Guadeloupe, Dominica, Martinique, St Lucia, St Vincent, the Grenadines and Grenada constituting the newest and highest summits of the Windward group, attaining heights approximating 5,000 feet in all the islands mentioned except the two most northern, Saba and St Eustatius, which rise 2,820 and 1,950 feet respectively, and the Grenadines.

GEOLOGY OF THE ISLANDS

The configuration and structure show that their history extends back to considerable antiquity. In the first place, while the primary configuration of all these islands is constructional—largely due to extrusive piling up—the present minor details of configuration, expressed in steep coastal bluffs, benches, slopes, and canyons, are modified by erosion, which has required considerable time for development. True crater shapes, except in St Eustatius, Nevis, and St Christopher, are inconspicuous, and are merely secondary summit features in the other islands, occurring parasitically upon masses of old eroded volcanic débris reaching a height of 4,000 feet, which have lost the features of their original contour through erosion. Secondly, the islands are all composed largely of vast piles of old tuffs and trachytic or andesitic débris of many eruptive epochs, like the volcanic heights of the Costa Rican plateau, which indicate long continuation of the vulcanism since comparatively remote geologic epochs, reaching back most probably to Eocene time.

This main or interior chain is composed of piled up volcanic débris, and upon the islands of Guadeloupe, Martinique, and St Vincent there have been active volcanic eruptions in historic time, 1797 in the former and 1812 in the latter. Soufrières, hot springs, etc., show that this activity is only slumbering quiescent in nearly all these islands. Besides, most of them still possess upon their summits one or more true craters, while Saba and St Eustatius are composed of simple crater cones now quiescent. While these facts attest recent eruptivity in the islands, there is much evidence presaging the conclusion that the present vulcanism is merely the survival of that which began earlier in geologic history, and that the main mass of the material composing the islands was ejected long before the dawn of human history.

True elevated reefs—normal, unaltered reef rocks raised by epeirogenic elevation to heights not exceeding 100 feet above the sea—do not occur near sea-level in the Leeward margin of the inner belt of the Caribbee Islands.

In St Christopher, St Eustatius, Guadeloupe, Martinique, St Lucia, and Grenada disturbed fossiliferous beds of Pleistocene or recent age are exceptionally found interbedded in volcanic débris of the lower slopes at altitudes of two or three hundred feet above the sea, showing that uplifting as well as extrusion has in part produced the present eminences, and that vulcanism existed in or prior to Pleistocene time. The fossils enumerated are hardly older than Pliocene and are most probably Pleistocene, and their border-like position shows that the greater mass of the islands were ejected in previous epochs.

So much for the main chain of the Caribbees considered by themselves; but the eastern belt, of the compound type, owe their present position above the sea-level to the epeirogenic uplifts which affected the Caribbean area in later geologic time.

In Guadeloupe we have much evidence concerning the evolution of the volcanic range and the mass of sedimentaries. This island is composed of two parts, of about equal area, separated by a shallow creek or strait, Rivière Salée. The most western of these islets (Basse-Terre) is a typical volcanic pile of the main Caribbee chain and is thoroughly mountainous. The most eastern area (Grande-Terre) is an elevated constructional plain, composed of sedimentary formations of Pleistocene age, underlain by a platform of volcanic tuffs, etc. Still to the eastward of Grande-Terre is the small terraced island of Desirade, composed entirely of organic material, which, with several other islets, stands above a shallow submerged platform extending out from the southeast end of Grande-Terre and Basse-Terre. To the southward of Grande-Terre is the island of Marie Galante, of the same topographic and geologic type as Grande Terre.

Moreau de Jonnes, in 1816, discovered that even these calcareous outer islands of the Caribbee chain rested on igneous formations. He showed that the calcareous islands were all situated externally to the windward of the volcanic shore, and that even in the volcanic islands where calcareous formations were also found the latter were always on the Atlantic side. In fact, there is evidence that the line of volcanic activity has migrated westward slowly during geologic periods.

Concerning the origin, relation, and succession of volcanic events the following facts can be stated: In late Cretaceous time vulcanism was active in the now quiescent regions of the North Mexican and Trans-Pecos Cordilleras, the Coastal Plain of Texas, the Isthmus of Panama, and the Great Antilles, Jamaica then being a volcanic island. The late Cretaceous limestones of Costa Rica contain angular specks of volcanic material intermixed with them, as also do the late Eocene sediments of Panama, which facts lead us to believe that the present Central American volcanic plateau has been an intermittent locus of volcanic activity from the Cretaceous to the present, as also has the volcanic region of Mexico.

The volcanoes of the Windward Islands, in my opinion, date back to at least the Eocene. Later in the Miocene vulcanism became quiescent in the great Antilles, but continued in the four great loci of present activity—Southern Mexico, the Northern Andes, Central America, and the Windward Islands. In the last two regions mentioned the greater masses of the present volcanic heights were piled up before the Pliocene, and the present craters are merely secondary and expiring phenomena.

Synchronously with the regional uplifts of late geologic time, volcanic piling has continued on the mainland and in the Windward Islands, although the mass of ejecta during these later days is Lilliputian in comparison with the great heaps of débris piled up in preceding epochs. The present craters and vents of the Mexican, Costa Rican, and Windward summits are mere ant-hills capping older mountains of ejecta. The last volcanic fires of the Cordilleran region of Northern Mexico and the United States expired in Pleistocene time.

CARIBBEE VOLCANOES*

It has been so long since any explosions have occurred in the Caribbee Islands that most geographers as well as the inhabitants were of the opinion that the forces which produced them were spent, and classified them as extinct volcanoes. Hurricanes, plagues, misgovernment, and French-English wars played frequent havoc with these people, but the calamity resulting from the explosion of these volcanoes is one of which they hardly dreamed. They looked upon the verdure-clad slopes only as the home of the sprites and goblins which abound in their peculiar folklore, and of the dreaded *fer de lance*, one of the most fatal serpents in existence, which inhabits only the islands of Martinique and St Lucia. Even the previous eruptions in Guadeloupe and St Vincent and Martinique in 1851 had not disturbed their faith in the perfect security of the beloved mornes.

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* It is one of the most lamentable admissions of our lack of geographic knowledge to state that no traveler, geologist, or explorer has ever systematically visited all these vents and craters or published anything upon them as an entirety. I must confess that in my own studies of the islands there were more difficult problems of paleontology, stratigraphy, and physiography throwing light upon their evolution and history, which occupied my time and attention.

Within human history there have before been but two serious eruptions in the Caribbee Islands, and both of them were in St Vincent (1718 and 1812), but one of the latter, like the present catastrophe, was one of the most appalling and destructive the world has ever seen. In 1812 the mountain of Morne Garon, on the Island of St. Vincent, about 90 miles south of Martinique, erupted. The explosion was a most fatal and far-reaching cataclysm, being equaled in recent years only by that of Krakatoa, in the Straits of Sunda. It was preceded by earthquakes. In Caracas 10,000 persons were buried in a single moment, and after this great event ruin was wrought all along the line of the Andes by earthquakes.

All down the range of the Antilles from Saba to Grenada there is hardly an island without its "soufrière" or solfatara—the crater, it would seem, of some volcano whose eruptive energy has dwindled into that milder form. Some of these soufrières are wholly or almost extinct, and have subsided into mere yellow-tinged ashpits, where perhaps the scanty thread of light vapor or a tepid spring finds its way through the surface. Others again are still active.

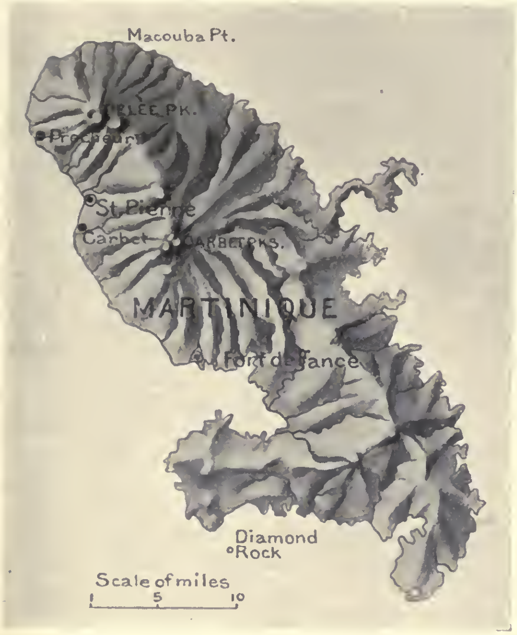
The soufrières or craters of the Caribbee Islands are not symmetrical cones sloping within to a central vent, but are of the type known as calderas—that is, broad flat basins within the area of a larger broken encircling rim, marked by vents with more or less sub-vertical walls, exhibiting the stratified layers of ejecta of former explosions. The walls of the vents or pits are destructional and not constructional, as are the walls of typical lapilli and lava cones.

Although called quiescent, the volcanoes of several of the Caribbee Islands have shown more or less evidence of continuous activity. The soufrières of Guadeloupe and St Lucia and Mt Misery on St Kitts have almost continuously ejected small jets of steam; the "Boiling Lake" of Dominica may also be considered as a volcanic manifestation. Numerous hot springs on most of the islands also indicated the presence comparatively near the surface of great heat in the rocks.

The northern islands of the necklace, like Saba and St Eustatius, are simpler volcanic piles with dominating crater cones, but the center of the chain consists of five larger islands—Guadeloupe, Dominica, Martinique, St Lucia, and St Vincent—each of which is a complicated mass of ancient combined constructional and destructional forms, accompanied by a few volcanic vents, whose peaks attain their greatest height in Mount Diablotin in Dominica.

The Island of St Eustatius, 2,000 feet in altitude, is a typical crater form and is surrounded by a depression called the Punch Bowl.

St Kitts is dominated by Mount Misery, with a summit crater 1,000 feet deep which is a lake in the rainy season. Hundreds of fissures in the flank of the mountain continue to emit solfataric sulphurous gas. Montserrat has two culminating peaks. One of these is a cone called La Soufrière, from which hot vapors still erupt.



Sketch Map of Martinique

THE VOLCANOES OF GUADELOUPE

The western Island of Guadeloupe has four lofty igneous cones—Grosse-Montagne (2,370 feet) in the northwest, whence radiate various ridges nearly at the same elevation; the Deux Mamelles (2,540), with La Soufrière (4,900) farther south, and toward the southern extremity the Caraibe (2,300), with Houelmont (1,800). These various masses merge in an irregular sinuous range, whose watershed has been incessantly modified by the erosive action of the tropical rains.

Solfataric igneous energy is still active in Guadeloupe at one or two points, such as Bouillante, at the foot of the Mamelles on the Caribbean Sea, where little craters in the sands emit hot vapors and warm waters bubble up in the sea; even in the sea gas bubbles rising from the marine bed are often seen bursting on the surface. The supreme crest of La Soufrière stands in the center of a plain which was probably a crater and which still discharges sulphuretted hydrogen. A circle of crests incloses the Petite Plaine, a depression which also represents an old crater. Gas continues to escape from a deep fissure in the center, which contains the sulphur deposits whence the mountain takes its name. Numerous thermal springs flow from the outer slopes.

The Islands of Les Saintes, a group of rocky headlands south of Guadeloupe, represent the scene of another prehistoric explosion in the Caribbean chain. These islets are the fragmentary remains of two volcanoes which were disposed in the same direction as those of Guadeloupe and Dominica. Of the seven separate rocks some are fractured craters, others are lapilli heaps resting on a submarine volcano, the highest point being Le Chameau (1,040 feet), in Terre-de-Haut, on the east side of the group. In the Les Saintes, according to personally communicated information from U. S. Consul Louis M. Ayme, there are large bluffs of alum, which are the product, no doubt, of sulphurous vapors, SO_2, acting on alumina.

THE BOILING LAKE OF DOMINICA

Mont Diablotin, the culminating point of Dominica, rivals the Grand Soufrière of Guadeloupe in altitude, and according to Bulkeley, who gives it a height of 5,340 feet, it is the most elevated summit of the whole range of the Lesser Antilles. The Grand Soufrière near its summit is one of the largest of all the quiescent craters of the Caribs. Several smaller and more accessible soufrières are scattered throughout this highly volcanic island. A cloud always hovers above the Grand Soufrière.

Diablotin stands at the northern extremity of the island, overtopping by about 2,500 feet an old crater in the interior, which till recently was still flooded by a "boiling" lake—that is, heated by thermal springs bubbling up from the bottom, and every five minutes upheaving the waters in a foaming column. Within a short distance of the margin the tarn was no less than 300 feet deep. In 1880 great landslips took place, new craters were opened in the hills, the columns of water disappeared, and the lacustrine basin lost much of its beauty. The fissures emitting gases were continually shifting their position, and the rivulet flowing from the lake was swollen along its course by springs of sulphurous water descending from crevasses in the upland valley.

The boiling lake of Dominica is a great caldera surrounded by precipitous cliffs several hundred feet in height, at the bottom of which is a large valley, originally reeking with thick white sulphur vapor, which turned black every article of silver carried on the bodies of persons who overlooked it. The soft bed of lapilli that paves the floor of the caldera is incrusted with sulphur in spots, from which rises a mixture of boiling water and steam, making a constant tumult of noises. The waters—white, black, and red in color—rush out in a strong torrent, scalding hot.

A traveler describes this caldera as fenced in by steep perpendicular banks or cliffs, varying from 60 to 100 feet high, cut out of ash and pumice. In the bottom of this was a giant seething caldron, which raged and roared like a wild beast in a cage. Toward the center, where the ebullition was fiercest, geyser-like masses were thrown up to a height of several feet, not always from the same spot, but shifting from side to side, each burst being preceded by a noise like the firing of a cannon. The heat of the water was 185° Fahrenheit. The height of the lake was a little over 2,400 feet above the sea.

The volcanic phenomena of Martinique, which are the subject of this article, will be more fully described in the succeeding pages.

The crater at St Lucia known as Sulphur Mountain has an elevation of 1,000 feet and covers about four acres; the sides are barren and covered by deposits of sulphur. In the days of French possession a sanitarium was built around the boiling springs of its northern slope.

This volcano, 4,000 feet high, is still active, and in the chasms of its crater, lined with deposits of sulphur, the eruptive matter is constantly in a state of ebullition. Copious thermal waters bubble up in various parts of the island and one of the sulphurous streams still flows through a half-ruined establishment erected by the French before the Revolution. This soufrière occupies the floor of a steep crater cone and is pierced by a dozen large calderas, circular in form, 4 to 16 feet in diameter, each boiling furiously, one with coal-black water, another with milky white, a third with gray mud, a fourth with a mixture of all these, while the countless apertures, some barely an inch across, send up steam or hot water in noisy jets, and have done so since the first memories of the earliest colonists, nearly three centuries ago.

ST VINCENT BEFORE THE LAST ERUPTION

That St Vincent is volcanic is apparent from recent events, the relation of which must be left to those who are studying it, my recent visit having been confined to Martinique.

Before the present eruption the summit of La Soufrière, at the northern end of St Vincent, was 3,500 feet above sea-level, and had two craters. The first was three miles in circumference and 500 feet deep, and was separated from what is known as the new crater (of 1812) by a ridge of igneous material. This is a mere fragment of an ancient cone which, it is said, probably at one time rose to double the present height of the loftiest summits of the crater. Reports, contradictory in their details, all agree in the general statement that in the year 1718 a terrific eruption of La Soufrière buried the whole island and surrounding waters in ashes; it was, doubtless, on that occasion that the upper part of the cone was blown away. The ruptured mountain was still in a restless state in 1785; but in 1812 a deep lake flooded its terminal crater. The waters were agitated by frequent shocks, which corresponded with similar disturbances occurring simultaneously in both Americas and the Antilles.

During the year 1812 Morne Garon vomited vast clouds of dust which darkened the sun for an entire day and spread over a hundred miles of sea and land. The volumes of mud changed the configuration of the island, as well as its eastern end. The present crater, formed at that time, is half a mile in diameter and 500 feet deep, and is now a beautiful lake, walled in by rocky cliffs to a height of 800 feet. Its slopes have been re-covered with peaceful vegetation and fields of cane until the beginning of May last.

The volcanic uplands, culminating in a peak 2,750 feet high, were clothed with forest growths, which here and there reveal the mud streams and prismatic colonnades terminating in superb cliffs on the coast. Still open craters occur in several places, and two romantic lakelets, fringed with bamboo and tree ferns, are also probably flooded volcanic cones. Pleasant villas and country-seats are scattered over the valleys and on the slopes of the hills in the midst of verdant thickets and flower gardens. None of the Antilles surpass Grenada in sylvan charms, wealth of color, and fragrant blossom.

MARTINIQUE

GENERAL GEOGRAPHY

The surface of Martinique, about 380 square miles in area, is exceedingly mountainous and rugged. The island is irregular in outline. Its greatest length, north to south, is 49.6 miles; the greatest width, 18.6 miles. Its northern and western coast lines, except where the latter is indented by the great Cul de Sac or Fort de France Bay, are comparatively regular, but the eastern or windward coast is broken into numerous peninsulas, islands, and headlands by the erosive action of the strong surf driven by the trade winds against that shore.

In general, while all of the island is of rugged configuration, it may be divided into two conspicuous subdivisions by drawing a line north and south from the mouth of Lazard River, near the eastern extremity of Fort de France Bay, northward through the village of La Trinite. The Rivers Lazard and Galion separate the two divisions, and by encroachment will soon completely capture the slight divide now existing between them, and perhaps some day in the future separate Martinique into two divisions as Guadeloupe is now separated.

To the east of this line and south of the Bay of Fort de France, the country is comparatively less rugged, although still mountainous, and has a more ancient and degraded configuration.

The southern division of the island does not rise anywhere to the heights of the northwestern, the culminating point being Mont Vauclin, 1,567 feet.

This portion has lost most of its original constructional forms, and its ridges and valleys are principally the work of destructional erosion. The eastern border of this area between the long peninsula of Caravelle on the north and Portes-d'Enfer is cut into hundreds of shallow bays and inlets by the strong action of the heavy surf which everywhere on that side prevents free navigation, and the contour and topography of the adjacent sea border shows that this land once extended to the outer margin of the islands which now border it.

All the country north of the Bay of Fort de France and to the west of this line, geologically speaking, may be considered a newer configuration—a later geologic addition to the island—which preserves much of its original volcanic constructional form, dominated by two commanding subcircular central volcanic mountains, the northernmost of which is Montagne Pelée and the other the Pitons du Carbet.

The topography of this northwestern area is chiefly constructional, the peaks of Pelée and Carbet being original volcanic cones, while many of the sloping salients between the streams radiating from them to the sea are old cuestas of ejecta. Destructional processes, however, are also strongly evident in the erosive dissection of the old craters and of the valleys or fonds.

While Pelée and Carbet are apparently twin volcanoes, the latter is the older of the two, and, judging from the broken nature of its surrounding crater bowl, has been extinct from time immemorial. Its altitude is 3,960 feet.

Montagne Pelée, at the north end of the island—a little to the west of its north-south axis—is a conical circular peak surrounded on three sides by water as if it had risen parasitic from the sea and had been united to the mainland by the débris of its southern flank. Of Pelée more anon.

The cone of Carbet, rising to a height of 3,960 feet, is undoubtedly the remnant of a high cinder cone now dissected into several peaks. Besides the major peaks mentioned, there are hundreds of rugged wooded hills, called mornes, some of which may have been old volcanic vents, while others are results of erosion.

Besides these major features of the configuration, there are several minor details which are of importance. The first of these is the rugged configuration of the mountains and fonds and the abrupt nature of the coast line, consisting everywhere, especially on the leeward side, except at the mouths of the rivers, of steep vertical cliffs. It is singularly ill adapted for safe harbors convenient to its population, and there are none except the superb bay of Fort de France, perhaps the best in the Windward Islands. On the windward side the coast line is rugged; but everywhere it is plainly to be seen that the work of the sea is constantly restricting the area of the island by the action of its waves.

Not only the eastern coast, but the entire perimeter of Martinique is being restricted by this destructional process. The horizontal action of the waves, which are everywhere undermining the coasts at water line, results in steep cliffs along the northern and western sides and many bights upon the eastern shore. Furthermore, this action has clearly left around the island a shallow submarine bench, which is especially marked along the southern and eastern coasts.

Another feature are the little elevated deltoid valleys of alluvium at the mouths of the rivers on the west, which constitute the plain upon which Fort de France is built. These, with the elevated reefs off the east coast, indicate uplifts as having taken place. Still a third feature are the evidences of an older and higher level of erosion back of the city of Fort de France.

The surface of the island is deeply scored by nearly 200 streamways, following the bottoms of deep V-shaped canyons which radiate from its summits to the sea. Seventy little perennial rivers descend from the mountains, but only two of these are of any importance, the Rivière Lazard and the Rivière Capote. The valleys are justly termed fonds or depths.

Besides the numerous copious rivulets flowing into the sea, there are many warm springs in Martinique—the Fontaine-Chaude on the heights of Precheur, eight kilometers from St Pierre, the waters of Absalom, the springs near Didier, de Moutte, and of the Chain Bridge, places in the neighborhood of Fort de France. There are other springs not explored near l'Esperance, at Lareinty, Lamentin, and of the Frégate at François.

PEOPLE

The population of Martinique in 1894 was 189,500, or 470 people per square mile, all native with the exception of 1,307 born in France. These people, except a small sprinkling of white creoles, were colored or black, excepting a few Coolies, who had been brought from France. In general, the predominant population was a mixture of negro and European blood, with many peculiarities, which rendered them almost a distinct type. They were all, in comparison to the other West Indians, a well-to-do and prosperous people.

The principal cities of Martinique are Fort de France, population 17,274, and St Pierre, population 25,792. Besides these, there are many beautiful little villages along the coast. The town of La Trinite, on the east coast, is of considerable importance.

Fort de France, the capital, is of little or no commercial importance, being a political and social center. The place is of interest, however, and possesses the best dry dock in the Lesser Antilles.

St Pierre was the New York of Martinique, its social commercial metropolis and the center of all its industry and commercial life. Here were located all of the larger industries, including several large rum distilleries, ice plants, saw-mills, and furniture factories. It contained the two leading banks of the island—the Bank of Martinique and the English Colonial Bank.

If New York should be obliterated at a stroke, its loss to our country as a whole would not fall as severely upon us as has the loss of St Pierre upon the people of Martinique, for we have other coastal cities and harbors; but the entire commercial, financial, and business life of the Island of Martinique was centered at this place.

RAINFALL

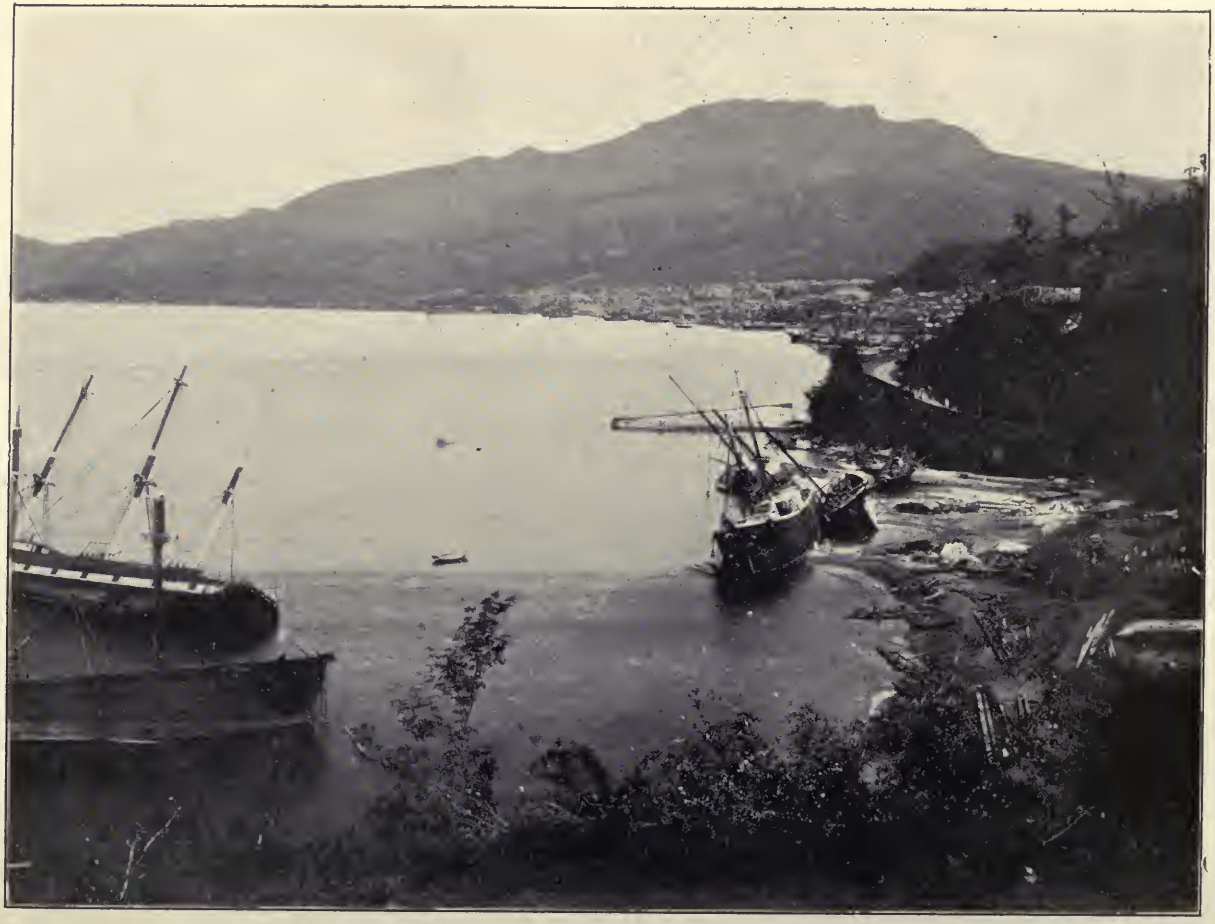
The annual rainfall of Martinique averaged 150 inches on the coast and 350 inches on the mountains. The temperature shows no variation from day to day throughout the year, but is freshened by winds. The seasons show a slight variation from the normal West Indian type, and were divided into three, as follows:

1. *Saison Fraiche*, December to March; rainfall, about 475 millimeters.
2. *Saison Chaude et Seche*, April to July; rainfall, 140 millimeters.
3. *Saison Chaude et Pluvieuse*, July to November; rainfall, 1121 millimeters.

The surface of the whole island, except a few spots near the summit of Pelée and the fields of cane, is covered by dense woodland. Much of this woodland is culture, however, for it must be remembered that the people of the tropics live largely by tree products. A greater part, however, especially on the uplands, is primitive jungle of tree ferns, palms, plantain, and tropical deciduous trees. Besides the great estates of cane, mostly on the eastern side, there are many small plantations of yams, potatoes, and other tropical "provisions."

MONTAGNE PELÉE

Montagne Pelée is a circular cone culminating in a single summit peak from which the broken surface slopes



The City of St Pierre Before the Eruption

The ships have been careened on the beach by a hurricane

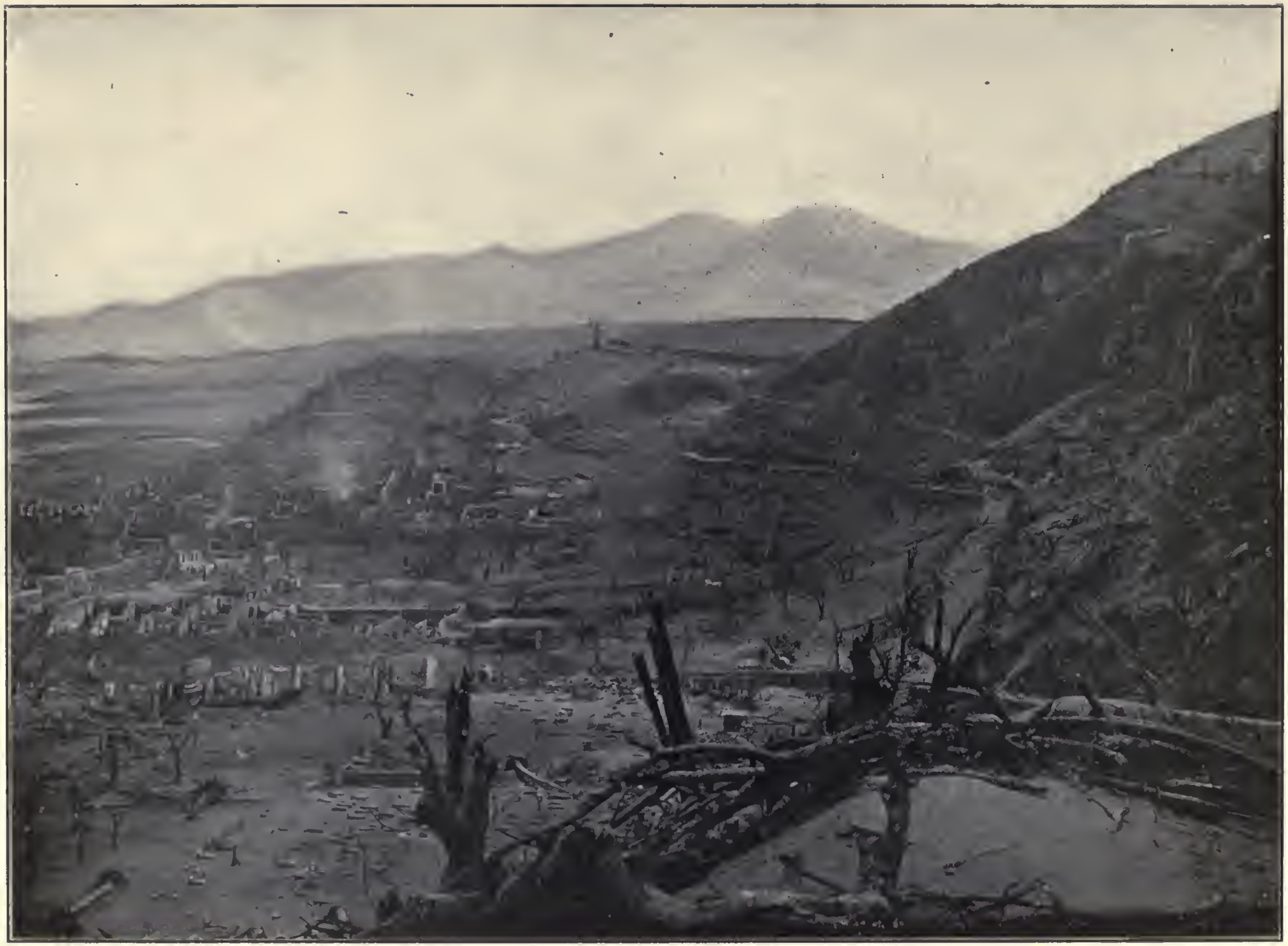


Photo by Israel C. Russell

The City of St Pierre After the Eruption in all directions to the sea, except toward the south, where its constructional slopes meet those of Carbet and form a neck of land. This general plan is modified, however, by bold strokes of nature's erosive carving, whereby the surface is cut into numerous radial divides and canyons.

The crest is a steeper hill surmounting larger piles composed of pumice. The top was a truncated loaf, in the summit of which is a bowl-shaped basin, the floor of the old caldera, which has existed since prehistoric time. Around this rim bowl was a circle of pointed hills, of which Morne La Croix, the highest, stood about 200 feet above the caldera floor upon its southwestern edge. In the floor of the caldera was a lake called L'Etang de Palmistes. It measured 150 meters in circumference, and varied in volume. This floor of the caldera was covered with pumiceous soil, beneath which were mud and boulders of pumice-stone.

The perimeter of Pelée where it meets the sea, except from the southern edge of St Pierre to the mouth of the Rivière Blanche to the northward, is everywhere bordered by steep bluffs, as if it had been encircled by a trimming knife. The ten rivers which were their branching headwaters, originating almost at the summit, diverged toward the sea and cut the sloping surface into numerous triangular segments.

The surface of one of these segments lying toward St Pierre is relatively of lower altitude than those which surround it, and does not bluff upon the sea as the others do, although it is bordered by steep cliffs on the north and south of the Rivières Blanche and Mouillage respectively. The surface of this lower-lying segment between the opposing cliffs is in turn etched of several other streams and presents within itself a varied topography.

The boundary cliffs run nearly from the summit nearly to the sea, where they suddenly diverge at right angles, parallel to it, leaving little strips of beach between. This cliff-bound area is a great natural amphitheater. Upon one of these narrow lateral beaches at the south end the principal part of the town of St Pierre was built. In other words, St Pierre lay within the southern edge of the natural amphitheater, surrounded by steep cliffs and closely built against one of the latter. This is an important fact, which, should the explosive theory prove true, would explain much of the damage which has been wrought.

GEOLOGY OF MARTINIQUE*

Nowhere in the rocks of Martinique has there been discovered any evidence of sedimentary rocks derived from a preexisting land, such as are found in Barbados and the Great Antilles, and this fact, which is also apparent in the other volcanic Caribbees, strongly upholds the conclusion that these islands were built up from the sea bottom solely through the agency of piled-up volcanic ejecta.

The Island of Martinique is composed almost entirely of volcanic material. In addition to the volcanic rocks, there are two other types of formations which throw a great deal of light upon its geological history. These are, first, elevated estuary deposits of alluvial material at the mouths of its rivers on the west coast, and deposits of calcareous oceanic sediment resting upon a basement of older volcanic rocks eroding the east coast.

Along the southeast coast are some calcareous benches composed of material similar to that now forming off that shore, which have been elevated above the sea by epeirogenic movements. The calcareous formations are found notably at Sainte-Anne in the southwest peninsula of the island, which makes a great salient in the Strait of St Lucia, and of Vauclin to the windward of the main mass of volcanic rocks. The calcareous formations occur to the seaward of the igneous rocks not only in the vicinity of Sainte-Anne, but along the east coast through the districts of Marin and Vauclin almost to La Trinite. They form in this vicinity the eroded plateau of Pain de Sucre, and the Mornes of Cype, Bataille, Flambeau, and others, the summits of which are crowned by blocks of carbonate of lime, but one everywhere sees overlying volcanic rocks, which also occur in the Isle of the Table-au-Diable and Portes-d'Enfer.

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* The geology of Martinique has been published in detail by Moreau de Jonnes in 1814; Ch. Sainte-Claire-Deville in 1843. Recently Octave Hayot, of Martinique, published an essay on the subject.

The calcareous plateau or bench which forms the surface of the peninsula of Sainte-Anne is deposited on a *massif* of volcanic nature composed of a porphyry with white feldspar in a decomposed brick-colored matrix and very friable, owing to oxidation. These rocks are much jointed, like prismatic basalts. The superposed limestones have a thickness of 25 to 30 feet and are marked by horizontal bands. These calcareous formations are secondary and parasitic, however, for the main mass of the island is composed of volcanic material which has been piling up since the beginning of Tertiary time.

The volcanic rocks, which are predominantly of an andesitic nature, are of several ages and varieties. The older geological writings on the island, written before the present processes of classification had been adopted, classify them as trachytes, phonalites, and porphyries. The oldest of these are said to be trachytes of Miocene age, which are found in the southern peninsula. Reported as covering these are porphyroids, quartzites, porphyrites, and porphyries of Pliocene age in the central part of the island. The rocks so far mentioned are those exposed near the base of the volcanic piles. These are covered by great thicknesses of tuffs and later eruptive material, especially on the west side. The general surface of the volcanic rocks has also been thoroughly saturated by earth water and the minerals of their rocks decomposed, so that the rust line or zone of oxidation (regolith) is exceedingly deep.

The Pleistocene and recent eruptions seem to have been entirely of a pumiceous nature, and cover all the country to the north and notably in the Rivière Fallasse. Elsewhere in this Magazine Mr. J. S. Diller has published the results of his petrographic studies of rocks collected by the writer from the island, which show that the older rocks from the base of Pelée and Carbet are hypersthene and horneblende-hypersthene andesites, and the material of the later eruption hornblende-andesite pumice, while the later crater material of Carbet is dacite. Again, much of the material which we now call tuffs exposed in the same places are old mud flows or banks or layers of ashes (lapilli) which have been partially consolidated by the percolating moisture.

There is no evidence in the southern and eastern portions of the island of any volcanic activity within historic times. Omitting from further consideration the older southeastern divisions, the northwestern peninsula alone further concerns the present story.

The Pitons of Carbet and Pelée are the nipples of a pair of twin volcanic mountains which rise from 9,000 to 10,000 feet above their subterranean base. The 4,000 or 5,000 feet of these mountains exposed above the sea are everywhere composed of exactly the same mineral material ejected during their long volcanic history, but varying somewhat in form. At places in the neighborhood of Fort de France and St Pierre up to a height of 2,000 feet some of the rocks are massive crystallines, which undoubtedly were origi-

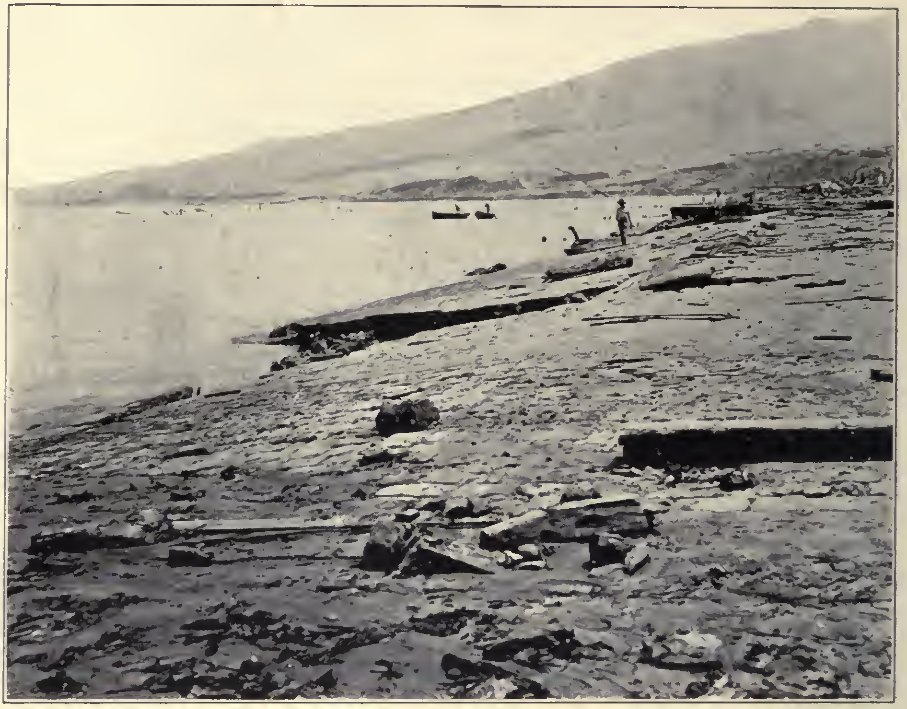


Photo by Robert T. Hill

The Beach shows the Force of the Return Wave (*page 261*)

nally either erupted as lava or represent the cooled stocks within the necks of former craters which have been exposed by erosion. The greater mass of the material, however, is in the form of volcanic tuffs and conglomerates representing the old crater-thrown débris, in many cases worked over by the streams of the successive eruptions. This is beautifully exposed in the numerous bluffs, from 50 to 200 feet in height, which everywhere mark the truncated line of the northwestern peninsula.

GEOLOGICAL HISTORY

The configuration and sequence of formations indicate the following important events in the history of the island:

1. That it originally consisted of volcanic piles rising from the sea bottom in the area along the eastern shore.

2. That Montagne Carbet and Pelée, constituting the northwestern promontory, are successively newer and later volcanoes, which have grown parasitic to the westward of the older and original volcanic site.

3. That Martinique has been losing in area to the eastward by the planation of the sea and growing to the westward by the successive eruptions of ejecta.

4. The elevated deltas and marine formations bordering the seacoast testify that in addition to the growth of this island by piling up of ejecta it has participated in the epeirogenic movements which marked the history of all the West Indies in late Tertiary and Pleistocene times.

POLITICAL CONDITIONS

Martinique is officially termed a colony of France. While this is true, it is not a colony as the American and English people understand that word. Our ideas of colonies are founded on the English conception, implying dependencies without participation or representation in the legislature of the mother country. To all intents and purposes the island is practically an integral part of France, with elected representatives to the French Senate Chamber, and the people possess as complete autonomy and liberty as the departments of France. In no sense is this government analogous to the colonial system of Great Britain, where the people do not possess citizenship or complete local self-government.

This is not the time or place to discuss colonial government. I only wish to make the point that the people of Martinique are free citizens of a republic which does everything within its power to foster and encourage and increase their prosperity, and leaves to them the fullest exercise of their personal rights and franchise. As a result, the local products and industries are most diversified; the peasantry are permitted to acquire and own places; the government is absolutely republican and democratic, and the people are of a most cheerful and contented disposition.

The English West Indies are blighted and dying from the colonial system of government. In Martinique there are still virility and hope It is true that the island has suffered from the decline in sugar, but, on the other hand, the government has met these conditions by

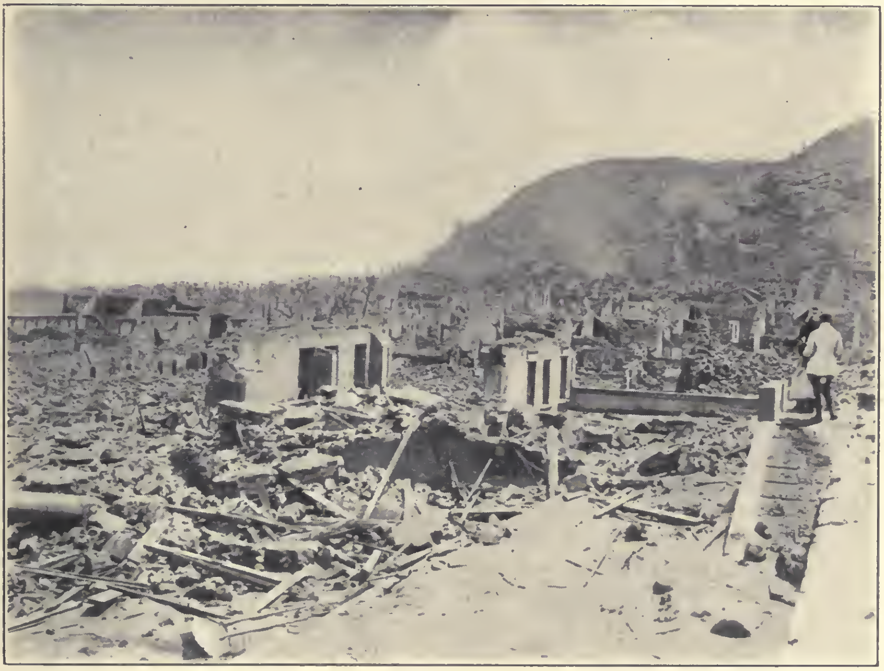


Photo by Robert T. Hill

Among the Ruins of St Pierre

improved methods of culture and refining, while diverse agriculture is practiced. Such temperate vegetables and fruits as lettuce and strawberries are grown by the Martinique people upon the higher slopes of the mountains, while upon the English islands the people do without these things because they say they cannot be grown. Cologne water, rum, and kid skins of an excellent quality for gloves, and other minor industries add considerable revenue.

It is also true, as the *Royal Mail Guide* stated, that there are no tennis courts or golf links in Martinique; but it has a landscape dotted throughout by homes of a happy peasantry, to say nothing of villas and estates where one can find all the refinement of modern Europe.

Neither is the administration of Martinique so bad as painted. Public improvements abound everywhere, and each commune possesses excellent schools. There are four great public hospitals upon the island and many high institutions of learning. The Lycée at St Pierre had a collegiate faculty which was apparently of excellent standing, and in the destroyed city were astronomic, physical, and meteorological laboratories, such as are found nowhere else in the islands. If the other colonial governments had been as enterprising in this respect, a store of knowledge would have been acquired during the present catastrophe which would at least have paid for the maintenance of such stations. Much attention was also paid to agricultural science in the Lycée at St Pierre, and some of the publications of its professors on this and botanical subjects are the best in existence.

ECONOMIC CONDITIONS

Notwithstanding the statements of Hearn and other writers concerning the decadent conditions in Martinique, from an economic standpoint, in comparison to all the neighboring Windward Islands, it is prosperous and flourishing and far better off in every way.

There were 1,150 sugar plantations on the island, with 19 central usines and 148 rum distilleries. There were also 422 kilometers of track for iron cars. The sugar is of the finest quality of white granulated. Muscovado such as is made in the British islands has long been abandoned. This product is entirely consumed in France.

In 1884 Martinique produced sugar to the value of $4,700,000 ; in 1898, only $2,732,213, the production of rum having increased from $1,600,000 to $1,800,000.

There were 1,500 hectares in cacao, and the exports were 635 tons, valued at $260,000 ; 6,000 hectares of coffee, producing 3,334,000 kilos, valued at $1,663,000. Campeahy-wood, vanilla, tobacco, indigo, and ginger were also probably grown.

Martinique imported from the United States horses, mules, salt and smoked meats, butter, oleomargarine, flour, fresh fruits, leaf tobacco, dried vegetables, lumber, coal, glass, vehicles, harness, clocks, sewing-machines, furniture, buckets, bottles, and lamps. Martinique imported cattle from our island possessions, Porto Rico and Vieques.

Above all, there are 10,000 *proprietes vivrieres*, or small peasantry holdings, in Martinique. It is estimated that each of these little properties utilizes three workmen to each cultivated hectare.

These small places yield a variety of culture, but produce little for export, apart from the cacao. A brief glance at one of these permits one to enumerate the principal products. At the side of the house there are trees furnishing fruits in abundance, mangos, avocatas, sapotilles, gayaves, caimites, carossols, star-apples, oranges, mandarines, limes, pamplemousses (a large citron fruit, which we call shaddock), citrons, bread-fruit trees, etc. ; then there are many kinds of banana

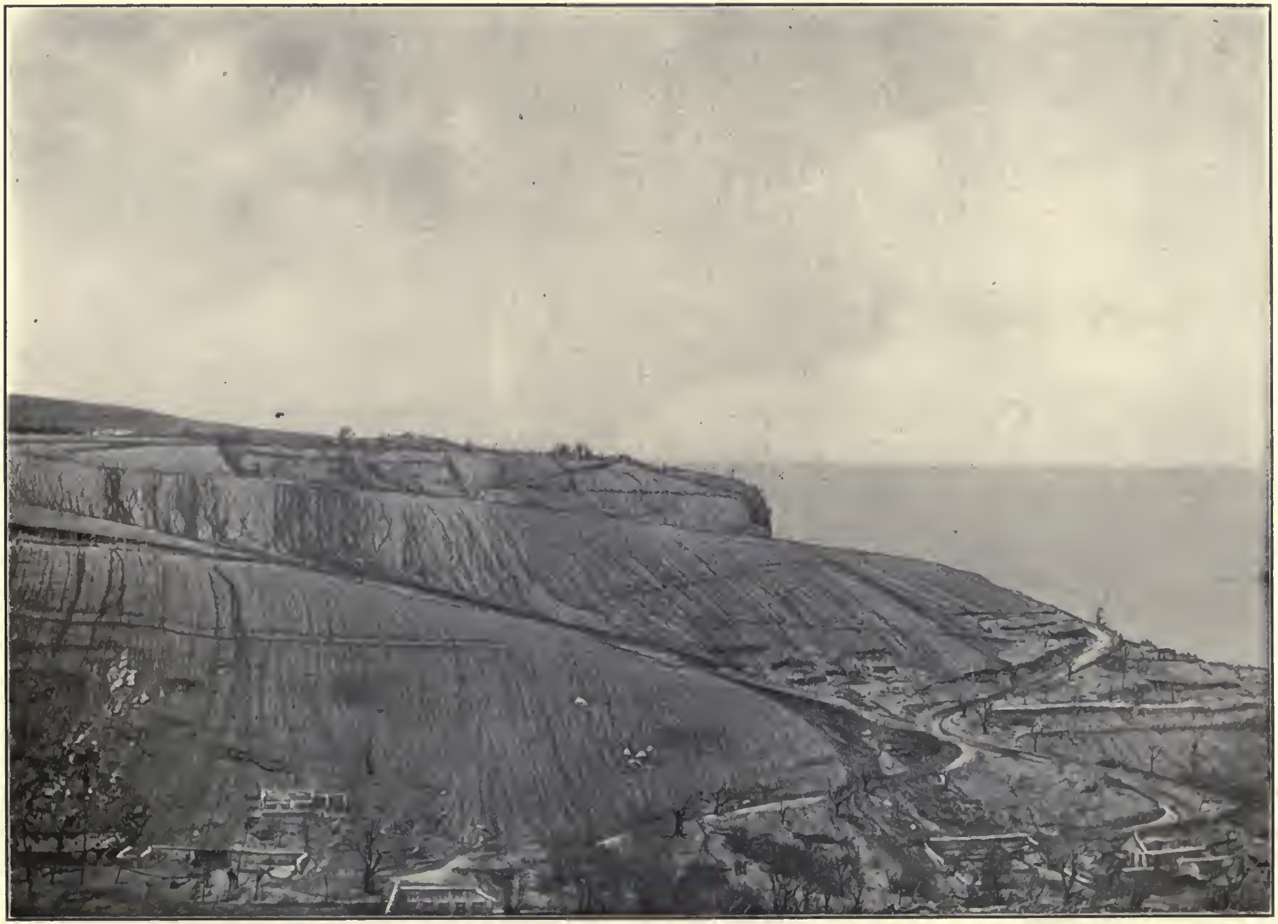


Photo by Israel C. Russell

Mud-plastered Landscape, South End of Morne d'Orange (*see page 258*)

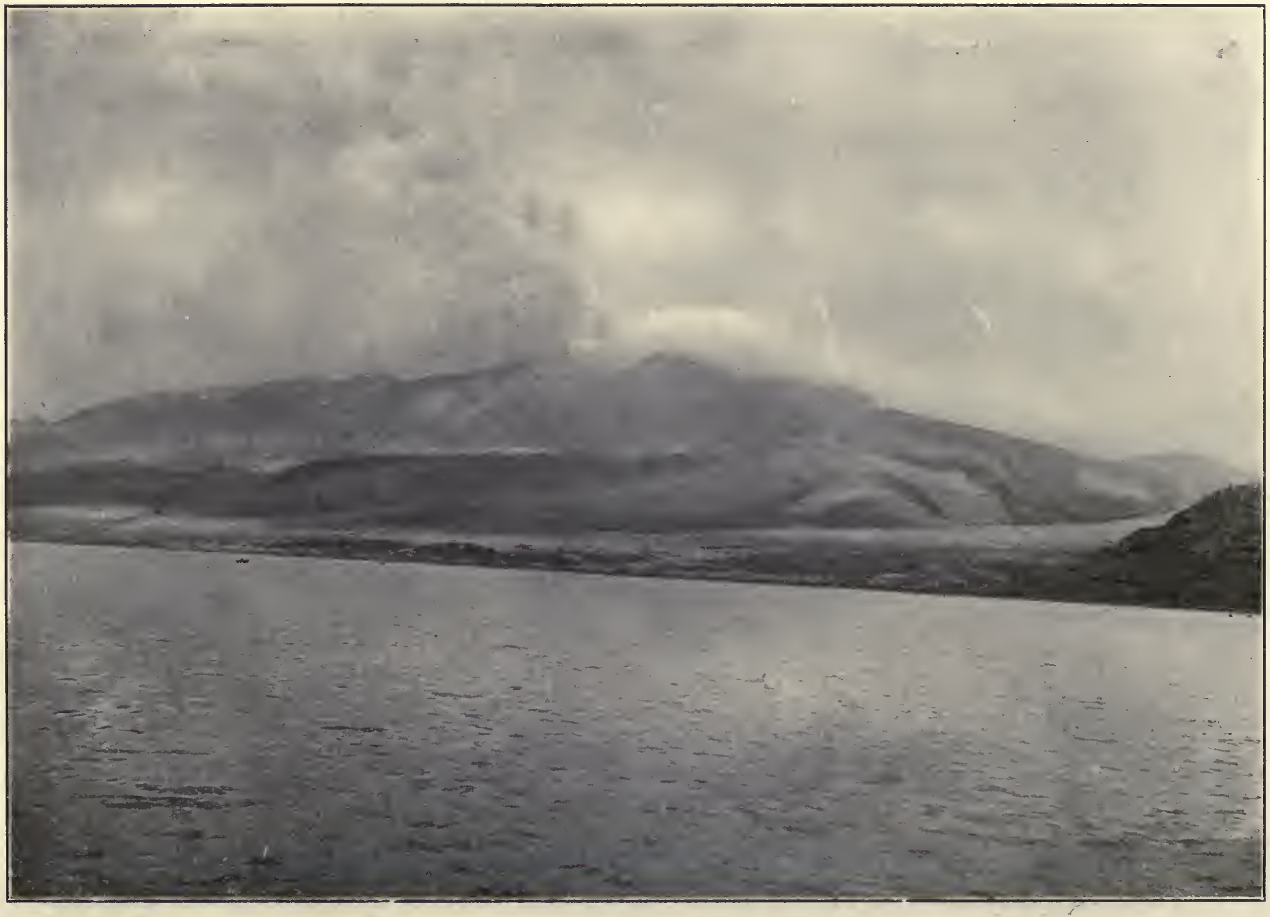


Photo by Israel C. Russell

Montagne Pelée and Destroyed North End of City

"In that triangular space, some 20 miles in area, there was not a thing left alive, not a tree left standing" (*see page 272*) plants, which produce various kinds of fruit, both of the peculiar species used for cooking purposes and the numerous varieties of fig bananas, which are eaten raw. There are also tuffs of sugar-cane, which is much appreciated as a food ; a few cacao trees, and some Arabian and Liberian coffee trees. Several varieties of spices also grow, and under a tunnel of bamboos one finds christophine, pommes-lianes, and barbadine, while in inclosures are planted vegetables and the Caribbee choux (a kind of root), colocases or Chinese cabbage, manioc, camaioc (the non-poisonous kind), and potatoes of different varieties.

About these small places there are also a few of many kinds of cattle—a small Creole horse to ride, a cow for milk, and a few pigs and some goats. In the southern part of the island one finds sheep. Near the seashore the small houses occupied by fishermen are surrounded by all the utensils necessary for this industry, such as coils of line, nets, and boats lying on the shore.

THE DISASTER

COMING EVENTS CAST THEIR SHADOWS BEFORE

The reader of current events is aware of the general features of the great tragedy which took place upon the 8th of May. This article will point out, so far as can be learned from the reports of today, the essential features of the catastrophe and their interpretation.

The people of Martinique looked upon Montagne Pelée with pride and love. Its charming ravines and forests were the home of myth and legend; the crater lake at its top a pleasure resort. That she would visit her children with calamity, the Creole could not believe.

Once before, in 1851, Pelée had grumbled. In the *Bulletin Official* of 1852, page 3, is recorded a tradition inherited from the Caribs, although without historical foundation, that Montagne Pelée had been the site of an active volcano. This tradition existed from the establishment of the first European settlements in the island and was most strongly impressed upon the people. The conical form of the mountain, similar to that of other volcanic peaks ; the epithet of "Pelée," or "shovelful," given to its summit ; the presence of a lake—all proved the existence of an ancient crater at that point. The pumiceous character of the soil for a radius of many leagues and the contour of the mountain showed the people that Pelée had a secret which they might well fear.

It is also an important fact that in one of the craters of this mountain was a place where sulphur had been found, to which the ominous name of La Soufrière had been given. This soufrière was not the summit lake, as was the case in St Vincent, but its position in one of the gorges to the southwest of the crater was significant.

But there has been more visible evidence that Pelée was a slumbering volcano than volcanic physiography and the above-mentioned Carib tradition left to the French settlers. It is true that Martinique had not had many earthquakes in its history. In 1839 there were some few movements that shook Fort de France. On the 10th of May, 1851, there were earthquakes in Martinique—rather unusual occurrences in the history of the island, although some of its neighbors are quite given to them. On the 5th of August, the same year, St Pierre awakened from its sleep to ascertain that it had a real volcano at its doors. Toward eleven o'clock at night sinister rumblings came from Pelée. When day broke, the people found their houses covered with gray ashes, which gave to the city the aspect of having been visited by a hoar-frost, and this ash covered all the country between Carbet, Morne Rouge, and Precheur, just as ashes now cover the same district. The Rivière Blanche also flowed a torrent of black or slaty mud, as it now flows.

But soon the rumblings ceased, the ashes turned into fertile soil, the Rivière Blanche once more assumed the color from which it derived its name, and St Pierre forgot the intimation which Pelée had given of the great secret within her heart until about a month before that secret destroyed her.

THE FIRST RUMBLINGS

Just when the present eruption began no one can tell. In the month of May, 1901, a year before the catastrophe, a picnic party to the summit of Pelée discovered a small fume rising from one corner of its ancient crater lake, which smelled of sulphur and killed the foliage of a tree from whose foot it ascended.

Mrs. Prentiss, wife of the American consul, in her letter to her sister, stated that on Wednesday, April 23, she heard three distinct shocks or reports in St Pierre, which were so great that the dishes were thrown from the shelves and the house rocked. These were probably the first effects of the present series of explosions noticed.

On April 25 everybody saw a great cloud of smoke toward Pelée, and from that date until the catastrophe small explosions of smoke and steam occurred. Professor Landes noticed these from April 25 to May 7.

Friday, April 25, Julien Romaine observed a wreath of smoke rising from the summit crater. He went up to investigate, and saw a remarkable black mixture of bituminous appearance bubbling and boiling, rising and puffing. Jets of white vapor and boiling water escaped and then fell back brusquely.

On April 27 another eyewitness from St Pierre discovered, what should have been an alarming fact, that the lower Soufrière or L'Etang sec was in eruption. Looking down upon it from above, he saw a new hole some 26 feet deep and 39 feet wide, in the center of which was a top of molten column shimmering like glass and a muddy-water pool. From the cells of the funnel jets of steam fumed in the air, and ashes were everywhere around. The account was preserved in the *L' Colonie.* From time to time there were showers of ashes and cinders, and from April 28 rumblings were heard in St Pierre.

A gentleman writing to M. de Blowitz, correspondent of the London *Times* at Paris, noted that Pelée had been emitting clouds of smoke for three weeks, but the smoke seemed to be produced so normally that even those who were inclined to look on the dark side seemed not to dread the catastrophe.

From April 29 to May 5 ashes increased steadily, breathing became more uncomfortable, eyes smarted, and throats were sore. On April 29 ominous rumblings of the mountain were heard at St Pierre and whitish smoke was seen rising from the top. On that day fine dust began to sprinkle over the city.

From April 29 to May 5 the streams began to swell; the Roxelane and Des Peres became raging torrents, carrying débris and dead fishes through the city.

April 30 there were three tremblings of the earth, at 3.40, 5.10, and 6.10 a. m. "These were not noted by the people, because they took place horizontally," records the paper. Was there a seismoscope in St Pierre?

On May 2 the first series of eruptions occurred and ashes fell on St Pierre. Work was suspended at the Usine Guerin because of the clouds of ash and cinder. Could these have been from the Soufrière, hardly a mile away?

After this date it was continually noticed that columns of cinders and steam were produced at the exact spot where the new crater was found.

The eruption of May 3 occurred at eight bells, but its effect did not reach Fort de France. It was characterized principally by dense yellow-brown fumes and boiling mud, which ran down the Rivière Blanche.

At 1.05 p. m. the first mud flow came down the Rivière Blanche, which had been of a dark hue for many days. This caused Mr. Guerin, the proprietor of the Usine at this point, to prepare to depart. Mont Pelée also began to throw out dense clouds of smoke. At midnight the same day flames, accompanied with rumbling noises, lighted the sky, causing widespread terror. On this day the first cable broke north of Martinique at an unknown distance from the shore. Then followed the first serious eruption of ashes.

A rain of cinders which began at 7 p. m. prevented the steamer *Topaz* from approaching Precheur.

E. G., in *L'Colonie*, in his graphic account of his ascent to the summit after the first explosion of May 3, says the top of the mountain was all green and the destruction was far less than below. He also noted that a new caldera had formed in the old crater and was boiling up and flowing into the Lake de Palmiste. As it did not fill up the lake, he concluded that it had a subterranean outlet into the Rivière Blanche. On the 4th of May birds died from asphyxiation from ashes, and this river became a torrent of mud and pumice, large quantities of which began to flow, causing much alarm as to what the night would bring forth. Hot ashes also covered the whole city quarter of St Pierre an inch thick, and while falling made Mont Pelée invisible.

Monday, May 5, at 5 a. m., the eruption of Pelée seemed ended and a calmer state prevailed, although cinders con-

Photo by Israel C. Russell

Mud-coated Surface and Injured Trees, Morne d'Orange (*see page 259*) tinued to fall on Precheur. At noon a stream of liquid volcanic matter flowed down the mountain side and reached the sea, five miles away, in three minutes. In its rush the flood swept from its path plantations, buildings, factories, cattle, and human beings over a breadth of about half a mile along the Rivière Blanche.

At the mouth of the Rivière Blanche stood the large Guerin sugar factory, one of the finest on the island. It was completely entombed in the mud. The tall chimney alone remained visible. One hundred and fifty persons, it is estimated, perished there, including the owner's son, but the officials give a smaller number.

A remarkable phenomenon occurred after the rush of the mud to the sea. At the mouth of the Rivière Blanche the sea receded at 12.25 p. m., all along the west coast, for a distance of about 100 yards, and returned with gentle strength, covering the whole sea front of St Pierre and reaching the first houses on the Place Bertin. This created a general panic, and the terror-stricken people fled to the hills, though the sea retired again without any great damage.

Terrible detonations were heard hundreds of miles northward, at short intervals, and continued at night. The electric lights failed, but the town was lighted by the flashes of flame from the mountain. Terror-stricken inhabitants rushed for the hills screaming and wailing.

At 7.45 p. m. the cable from Fort de France broke to the north. The end of this cable was later picked up 10 miles due west of St Pierre in 2,500 meters of water.

Professor Landes, who published an interview in *L' Colonie* of May 7, noted that Rivière Blanche at this time was furnishing five times the volume of the greatest power and carrying rocks weighing perhaps fifty tons. This was before May 5.

The *Topaz* refugees stated that on May 5 terrible detonations broke from the mountain at short and irregular intervals, accompanied by dense smoke and lurid flashes. This was awful in daylight, but when darkness fell it was still more terrible.

The awful phenomena of May 5 were so terrifying that people in their night clothes, carrying children, and lighted by any sort of lamp or candle they had caught up in their haste, ran out into the dark streets wailing and screaming and running aimlessly about the town. The mental strain became unbearable, and the *Topaz* was got ready at 3 a. m., and the refugees hurriedly got on board and started at 5 a. m. for St Lucia, where they arrived at 11 o'clock on the morning of the 6th.

On May 6 Pelée was apparently in full eruption. Its detonations were heard in Guadeloupe for two or three hours, and thick clouds overshadowed the summit of Pelée. Fond de Core was abandoned and cinders fell in abundance on Macouba. Five centimeters of cinders had fallen in Precheur, a foot of cinders was reported in the center of the mountain, and three-tenths of a millimeter of cinders fell on St Pierre on that night. People were departing from St Pierre on foot to neighboring villages and by steamer to Fort de France. Country places were being abandoned for lack of water, cattle were dying, and trees breaking under cinder weight. On the afternoon of the 6th, a little before 5 p. m., telegraphic communication between Martinique, St Vincent, and St Lucia was interrupted. There were six cables leading into Martinique, all of which were eventually broken.

May 7, the day before the end, was one of horror in St Pierre, but the volcanic phenomena were not so vivid as before. Detonations like artillery were heard from 10.30 a. m. to 5 p. m. All that day the *Roraima* at Dominica and people of neighboring islands heard detonations. These even reached as far north as St Thomas. Similar detonations were heard in Barbados, but these may have been from St. Vincent, where the great eruption took place on this day.

On this morning a great crevasse was noticed at the base of Morne La Croix, on the side toward L'Etang sec. This was 100 meters long and 40 wide, and it was feared might undermine the mountain.

In the morning the cable operator at St Lucia received a message from the operator at St Pierre saying, "Red hot stones falling here; don't know how long I can hold out." At 2 p. m. Consul Ayme at Guadeloupe sent a message to the cable office and was informed that all cables north and south were broken. All the cables that went to Martinique were broken on the 7th.

Wednesday night, the 7th, the detonations ceased and fine ashes fell over St Pierre like rain.

The French Governor, M. Mouttet, who was at Fort de France, tried to stop the panic which the volcanic disturbance caused. He declared the danger would not increase, and sent a detachment of soldiers to prevent an exodus of officials, and later went himself with his wife to St Pierre, where they were destroyed.

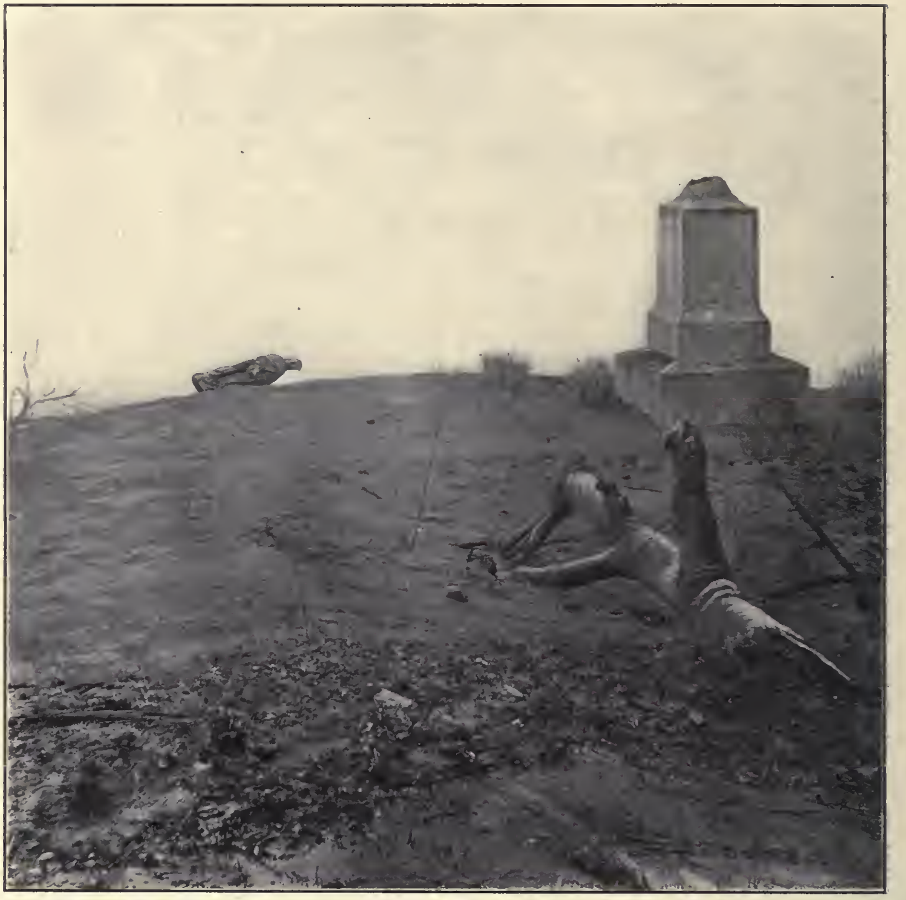
THE CATASTROPHE

At 6.30, May 8, the *Roraima*, then approaching St Pierre and her fate, reported ashes falling, although the day was fair and the sun bright and clear. It may also be of interest to note that at 7.50 on the morning of May 8 there was to be a new moon in St Pierre.

The rays of the rising sun had hardly descended over the mountain back of St Pierre on the morning of the 8th when, at 7.50 o'clock local time, a great volcanic cloud erupted and destroyed the city and its 30,000 people, seventeen ships in the anchorage, and all the country places between the cliffs of the Roxelane and the Rivière Blanche. The phenomena of this eruption, so far as I have been able to ascertain them, were as follows:

The Witnesses.—Witnesses of this terrible event were many, but of survivors there are few. Of these I personally interviewed Captain Freeman, of the *Roddam*, and Engineers Evans and Morris, of the *Roraima*, who witnessed the event from the sea side, and Mr Ferdinand Clerc and a dozen others who observed it from the land side. I have also carefully analyzed the printed reports of other witnesses.

Some of the witnesses of the eruptions could see only a portion of the phenomena. Father Alte Roché, at Mont Verte, whose story is the most intelligible of those from the land side, could see the summit, but intervening ridges obscured his view of the lower vent and St Pierre. This also was the case with M. Levenaire, who lived northeast of Morne Rouge. The witnesses from the ships could see the sequence of eruptions; but as the edge of the dense black aërial mass of ashes approached them the cloud itself cut off their observation of those things taking place over the city which could be seen by observers from the land side. All of the witnesses, many of them frightfully injured, were too busily engaged in securing their own safety to devote their attention to the phenomena exclusively. Two have given unusually intelligible and accurate accounts of what they witnessed. These are Father Alte Roché, of Mont Verte, and Second Engineer Chas. Evans, of the *Roraima*. I was associated with the latter for a week upon our return on the *Dixie*. The story of Father Alte Roché was given by Mr Skinner in the New York *Times*. Many other witnesses have noted important single facts.



South Photo by Israel C. Russell North

Statue of Our Lady of the Watch, Morne d'Orange, South End of City

This statue, weighing several tons, was hurled 50 feet by the terrific blast (*see page 273*)

Preliminary Air Movement. — Mr Ferdinand Clerc, the chief planter of the island, whose miraculous escape from the city at 7 o'clock on the morning of the 8th has been recorded, informed me that the needle of a large aneroid barometer hanging in his house fluctuated violently, and this fact determined him to leave the city. These fluctuations were undoubtedly disturbances in the air from explosions within the open crater.

Detonations.—Professor Arnoux, astronomer of the St Pierre observatory, at the time of the catastrophe was on the overlooking plateau of Mont Parnaise. He had distinctly heard detonations when the eruption took place.

Jean Marie Evans, a foreman of the Raibaud estate, two miles southeast from St Pierre, in a deep valley, also told me that there were frightful detonations in the mountain just preceding the eruption.

The Eruption.—All witnesses agree that St Pierre was overwhelmed by a cloud of aërial volcanic ejecta, which traveled with great rapidity across from the mountain over the city.

It may be noted here that in all of the many subsequent eruptions which I personally witnessed, those from the summit, especially when black in color and of dense lapilli (ash clouds), boiled out in great balloon or mushroom-shaped clouds, with numerous rolling convolutions, usually dissipating above, but sometimes floating away in great horizontal ribbons. Those from the lower vent were wide columns of brownish smoke, without convolutions, and traveled along the ground surface to the sea.

A Sequence of Eruptions.—According to Charles Evans, the second engineer of the *Roraima*, who with another engineer (killed) was looking at the mountain from the deck, there were three eruptions: First, there was a big puff of smoke from the top of the mountain, not accompanied by noise, which mushroomed and spread out. Then, after a noticeable interval, there was a second and larger eruption (the destructive one) *which did not come from the top of the mountain, but from the side*, and which did not ascend, but rushed down toward him and the city in two great horizontal puffs. On seeing this, the fatal eruption, Mr Evans ran down to the engine-room from the deck. Returning on deck, burned and suffering, he saw a third and irrelevant eruption, which took place in about five minutes after the second one. Evans is positive that the second blast destroyed the town. Camille Houly, at Belle Oncle,

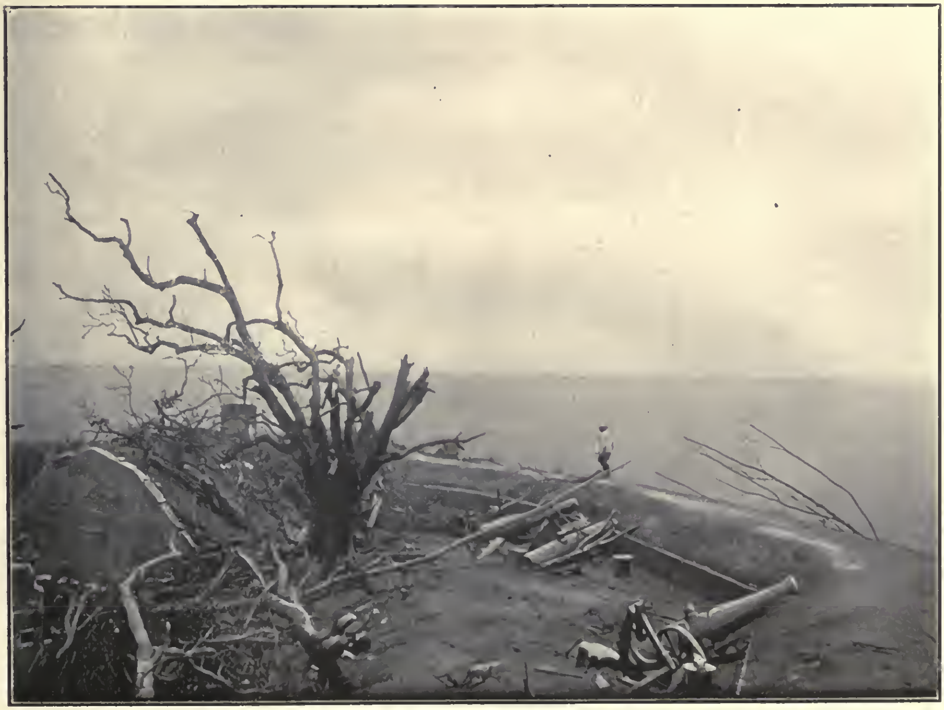


Photo by Israel C. Russell

Guns of Battery on Morne d'Orange Dismounted by the Blast (*see page 273*) a suburb, also saw the mountain "apparently open over an area of 100 to 200 meters *at a point fully 1,000 meters below the summit.*"

Father Alte Roché, from the high position of Monte Verte, 3½ kilometers south of St Pierre, had a clear view of the mountain, but not of the city or lower vent. He saw a dense column shoot up from the summit of the crater like a column of smoke and steam, which "spread out like the leaves of a palm tree."

Jean Marie Evans, in a valley of the Raibaud estate, one mile southeast of St Pierre, saw the cloud coming out of the top of the mountain, and ran. He said the cloud did not go up in the air like smoke. "It went high, but not like smoke," meaning that it was like a ball or cauliflower, instead of columns.

Mademoiselle Lavenaire, from her father's estate, Beauvalon, 3½ miles northeast of Morne Rouge, and 1½ miles from the crater, saw a column of black smoke issue from the summit of the crater, which did not rise, but settled down toward St Pierre.

Composition of the Cloud. — Its visible composition was of a dense mass of hot ash-like lapilli (ash), which everywhere filled the air. Besides this, gases and superheated steam were apparently present, as will be shown. A ton of ashes was found in the officers' mess on the *Roraima*. From 50 to 100 tons fell upon the deck of the *Roddam;* less than a foot of ashes fell in all the eruptions on the streets of St Pierre. These were piled highest against the north wall.

Density.—The cloud, as seen approaching from the sea, was dense, opaque, and of a brownish black color. Its density was so great as to cause total darkness of positions it enveloped.

Weight.—The cloud was heavier than the air. It traveled along the surface of the earth's configuration instead of ascending. Owing to this heaviness, houses, estates, trees, and people on the higher cliffs above St Pierre were spared, as well as the trees on the southwestern slope of the high summit of area of Pelée.

Motion.—The cloud advanced horizontically through the air, following the configuration at the minimum rate of a mile a minute. Besides the progressive motion, its convolutions surged and rolled. No witnesses could testify positively to a revolving (cyclonic) motion. Some say that it rolled vertically. The priest at Precheur stated that trees fell circularly, but all the fallen trees at that place lie in one direction.

Direction.—The path of the cloud was from east of north to west of south. The area of its destruction is elsewhere discussed. An interesting fact told by Engineer Evans is that "the cloud came against the wind." I cannot interpret this phenomenon. Was there a tremendous indraft?

Heat.—The cloud was hot. All witnesses spared testified to feeling its heat even when beyond its margin. The ashes were hot for hours on the *Roddam*, and still warm when dug into by me thirteen days after the eruption. The lapilli falling upon the *Roraima* were sufficiently hot to cause ignition of rope and bedding, but not to ignite woodwork or the pitch-pine timber on its forward deck.

Mlle. Lavenaire, 7½ miles northeast of St Pierre, to the east of the amphitheater, felt a blast of hot air. Others on the margin of the disaster testify to the hot air. The writer has personally felt the hot blasts of air from subsequent eruptions.

Steam.—In addition to the hot lapilli, there was an invisibie heated substance in the cloud which penetrated clothing without firing it and burned the human skin beneath, as attested by the burns upon the back of Engineer Morris, the breast of Nurse Clara, and others. It is possible that this was superheated steam.

Lack of Incandescence.—There is no testimony that the destructive cloud or its lapilli were incandescent. All parties who witnessed the cloud from the front (advance) testify that they saw no flame or incandescence in it. There is positive evidence that the cloud, in one place at least, was not incandescent. Engineer Evans, of the *Roraima*, who looked up through a skylight as out of a well, says he saw no fire or light in the dense cloud above him. His point of view was the outer side of the destructive circle.

Photo by Robert T. Hill

A Flash of Lightning in Clouds Erupted from Pelée

Flame.—There is much evidence that flame developed in the cloud after its eruption. All persons who witnessed the cloud from the rear or land side testify to seeing great sheets of flame or fire develop within the cloud, suggestive of sudden ignition. Priest Des Prez, of Precheur, saw red fire in the air following after other phenomena observed by him. "In the city behind the smoke came a sheet of flame," said Mr Le Clerc. Victor, a native, whom I met at Deux Choux, six miles from St Pierre, and who saw the eruption from a neighboring estate, stated that at the time of the explosion for a moment he saw the heavens clouded with flame; five minutes afterward total darkness.

Professor Arnoux says that after the cloud had settled over the city there was a flash of flame and he put his hand over his face to shut out the awful sight.

Father Alte Roché states that after having seen the summit cloud roll out, after having run from it 200 yards, and after having fallen down, as he got up he saw a blinding flash over the city. He said: "As I looked there was a blinding flash of fire, and in a moment the whole beautiful city was in flames. The flame seemed to travel like lightning over the city from north to south; but it was not lightning. It looked as if the black cloud from the mountain had been ignited as soon as it reached the city."

Mlle. Lavenaire, 7½ miles northeast of St Pierre and out of sight of town, saw a flash of flame within two minutes after the summit cloud had erupted.

Many testify that while the cloud was not visibly afire at the time of its eruption it inflamed objects in its path over the city. Evans said that wherever the cloud touched the houses in town they took fire. As the houses were of stone, with tin or tile roofing, containing but little combustible material, the temperature must have been intense to cause such sudden inflammation.

Lightning.—Tremendous displays of bolts and flashes were seen at St Vincent and Pelée within the clouds ejected from the volcano during eruptions. The evidence of lightning around the erupted summit clouds after they had left the crater is indisputably testified by many witnesses. I have personally witnessed the phenomena in subsequent eruptions.

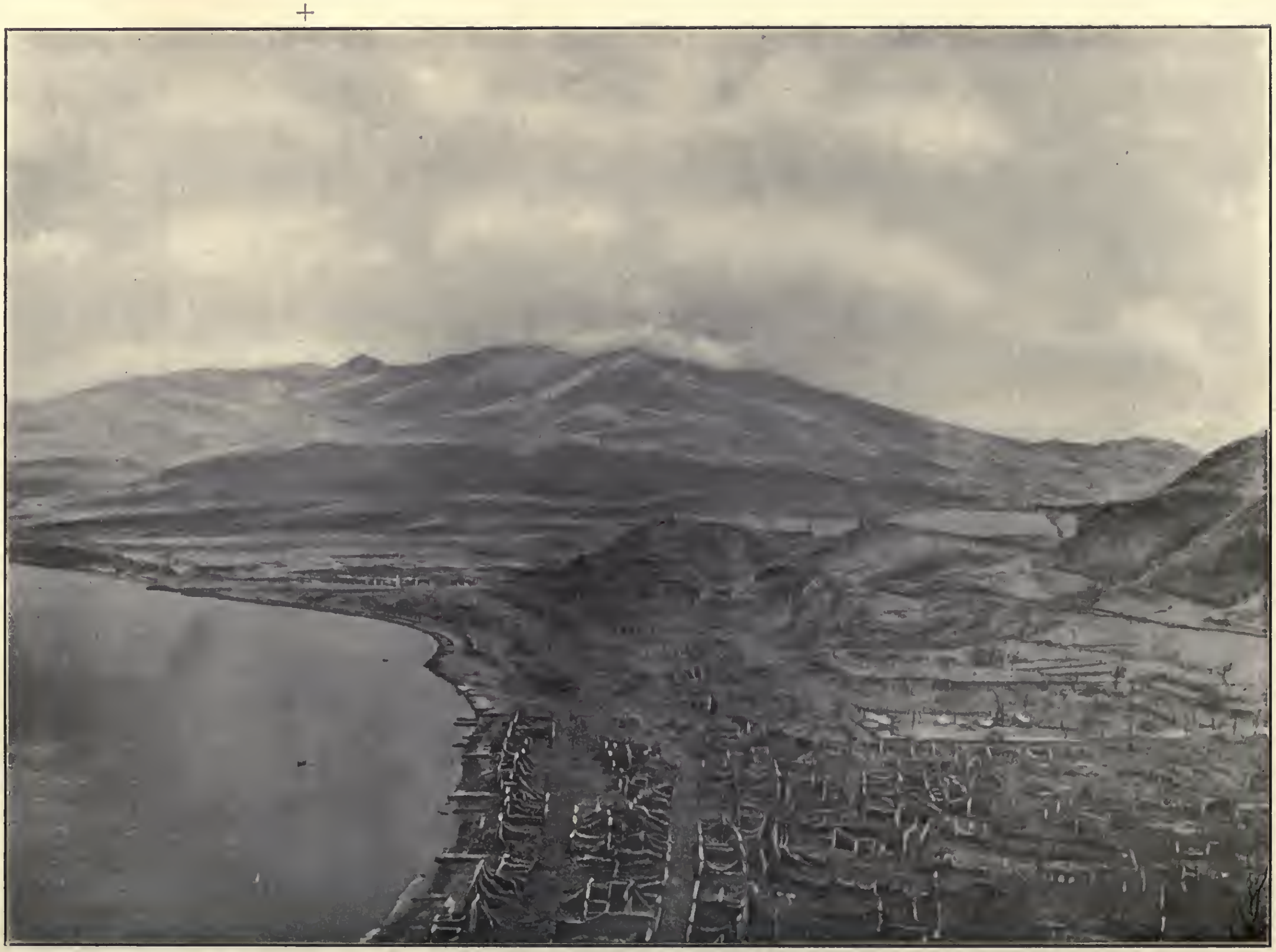


Photo by Israel C. Russell

"At my feet lay the dead city, silent and gray" (*see page 272*)

Showing summit of Pelée; standing walls south end of city; north end of city extended along coast to extreme left of picture. Lower vent, as located by Mr Hill, is behind the lower hill below the cross (+) in upper left-hand corner of picture

G. Mazot, in *L'Colonie* of May 5, stated, in describing the current eruptions, that "flashes of lightning in culminating zigzags moved the length of the mountain. This phenomena is produced during the night with a beautiful horror. The sparks shoot along the summit in every direction." Foreman Jean Marie Evans distinctly and voluntarily testified to me that there was much lightning on the St Pierre side during the eruption. Father Alte Roché saw lightning playing incessantly through the summit cloud preceding the catastrophe.

Scarcity of Visible Effects of Lightning Strokes.—There is no positive evidence of death or destruction from lightning, nor is there sufficient data to say that there were no such effects. No fulgurites were found, no splintered trees, no shattering. The ironwork was bent by combustion heat of the burning city. I saw hundreds of commercial bars of iron standing against the walls of a shop, which were unfused and unhurt. No fusion whatever of metals was observed. The only apparent electrical phenomenon reported is the allegation that Mr Clerc found that the iron cross which formerly surmounted Morne La Croix had been melted down to its stone pedestal.*

M. de Blowitz says that the telegraph office and its contents were burned, and that some fragments of the apparatus were thrown a hundred yards. The office might have been burned by electricity, but the throwing was not due to this cause.

The correspondent of the *Sun* of May 13 says that the bodies looked as though they had been struck by lightning; but this is not proven.

Important electric studies are being made by officials of the French fleet in the vicinity. It is an interesting coincidence that the marconigraphs on *L' Tage* were made useless during subsequent eruptions.

Magnetic Storm Probably Accompanied Phenomena. — Mr Otto H. Tittmann, Superintendent of the U. S. Coast and Geodetic Survey, reports that the delicately suspended magnetic needles at the two Coast and Geodetic Survey magnetic observatories—the one situated at Cheltenham, Md., 16 miles southeast of Washington, and the other at Baldwin, Kans., 17 miles south of Lawrence—were disturbed, beginning at about the time the catastrophe at St Pierre is reported to have occurred. The wave of fire struck St Pierre and a clock was stopped at 7.50. The magnetic disturbance began at the Cheltenham Observatory at a time corresponding to 7.53, St Pierre local mean time, and at the Baldwin Observatory 7.55, St Pierre time. This disturbance was also registered in Paris and in the Hawaiian Islands.

Evidence of Gaseous Substances within the Cloud.—There is no direct oral testimony of gas within the cloud, as the people who witnessed it were not students of gaseous phenomena. All silverware in the ruins was blackened, notably the bucket of plate rescued from Consul Prentiss' house by Consul Louis H. Ayme, which resembled old black junk. A silver platter picked up by an officer of the *Dixie* was black and corrugated. A bronze, silver, and gold image picked up by another officer was likewise blackened. In fact, every metal relic susceptible to sulphur discoloration showed its blackening effect. Twigs from the trees collected by me and analyzed by Dr Steiger, of the Geological Survey, showed a sulphurous coating.

The presence of sulphur gases may be reasonably inferred. The soufrières and most of the hot waters of the Caribbee craters are sulphurous and evict sulphureted hydrogen gases. Nearly all the old calderas contain native sulphur. The soufrière of Pelée receives its name from the sulphur found there. Parties who visited the summit a few days before the catastrophe, as recorded in *L'Colonie*, exposed silver and it was blackened. They noted black powder, resembling plumbago, covered trees near the crater; that the water of the lake contained great quantities of sulphureted hydrogen, and that when the water was put in bottles the gases forced out the corks.

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*The World's Work for July, received since the foregoing was written, states that Professor Heilprin has found evidences of lightning strokes on objects in the city.

The deputy mayor, Labat, told me that the captain of the *Suchet* picked up pieces of pure sulphur in the ruined streets of St Pierre on the afternoon of the catastrophe. A newspaper man describes splotches of flame on the ships, which might have been sulphur.

The city of St Pierre was filled with sulphureted smells for days before the eruption, as testified by the following extract from a letter by Mrs Prentiss, written and mailed a few days before her untimely death: "The smell of sulphur is so strong that horses on the street stop and snort, and some of them drop in their harness and die from suffocation. Many of the people are obliged to wear wet handkerchiefs to protect them from the strong fumes of sulphur."

A survivor named McDonald, who arrived in Norfolk, Virginia, on May 16, claims to have escaped from St Pierre to a ship in a rowboat, and that he was picked up by the *Suchet*. He said the air was filled with mud and lava, and the sulphur fumes were so strong that breathing was difficult.

Deputy Mayor Labat said that when he approached St Pierre on the evening of the explosion there was a terrific odor of sulphur in the air. I myself have smelled sulphur fumes in the air from later eruptions.

Foreman Evans said there was a little sulphur smell, but the smell was like something dry, like steam with a little sulphur.

Evidence of Steam.—Steam clouds were seen by Father Alte Roché, rising from the erupted clouds. Steam may be inferred, as it was present in all the eruptions subsequently seen. The burning of persons' bodies through their clothing without firing the clothing indicates the presence of steam, and the great rain of wet mud which followed the catastrophe from a cloudless sky, might theoretically be assigned to the condensation of steam ejected from the volcano.

Force.—A tremendous destructional force was apparent. It uprooted trees, destroyed buildings, threw people and objects, made the sea recede, overturned ships and destroyed their rigging. It is impossible to conceive that this force was initial from the volcanic vents, two and a half and five miles distant.

The Force Aërial, not Terrestrial.—Tops of walls were thrown down, foundations standing; pedestal standing, statue blown off; rigging and upper works blown off ships, hulls keeled over. The stones on which the light-house stood were torn asunder and thrown great distances. The statue of the Virgin, as observed by Professor Russell on the lower cliff near the south end of the city, was thrown to the south, with her head lying to the north. Many of the trees in the south edge of the town were thrown south against the cliff, although others in the town were sufficiently rooted to withstand the forces. Against the cliff in the southern part of the town are hundreds of tin roofs. On the cliff line above the town many trees are still standing with their branches and scorched foliage, and a red-roofed villa preserved there, with furniture and foliage intact, shows that the lines of fire did not reach there. Mr. Prudhomme, on the bark *Teresa lo Vico*, was thrown on deck, his wife on top of him.

The shock was felt as far as the village of Deux Choux, eight kilometers to the east, and Mont Vert, six kilometers south, where Father Alte Roché was thrown down.

According to Engineer Evans, there was a great horizontal disturbance of the water, caused by the aërial force. This struck the port quarter of the *Roraima*, her head being on shore. She keeled to the starboard, so that the bridge got under water and water came into the hold through the fiddlers. The wave lifted the *Roddam* so that her anchor chain broke, and she was enabled to escape. It also took James Taylor, of the *Roraima*, out to sea, and its return movement brought him back to a buoy, from which he was rescued. This return wave bit little triangular pieces out of the beach.

The direction of the force was radial apparently from a center. In the south end of the city objects were blown southward by force from the north, the north and south ends of buildings blown in. The *Roraima*, at buoy, was struck by force from north; the *Grappler*, at mouth of the Rivière Pères, off the north edge of the city, was destroyed by force from the east; trees in the vicinity of the Rivière Mare were blown by force from the southeast; bamboo and foliage slopes of the eastern cliff toward Morne Rouge were bent by force from the west, the Jardin des Plantes destroyed by force from west of north.

The Center of Force.—This seems to have been near the north end of the city where destruction was greatest, the effects decreasing radially in all directions. Among the evidences of force are the fact that in the northern part of St Pierre the buildings were absolutely pulverized. Not a vestige was left of the little village of Fond Core, north of the city. It is said that not a piece could be found of the great rum factory, with its heavy iron machinery and castings.

Return Force.—A return force is evidenced by the south end of buildings blown northward and by the testimony of witnesses. Father Alte Roché, three miles south, who was knocked down and gasping for air, says "a breeze sprung up from the south and revived me." Engineer Evans says that the force had the strength of a hurricane, and noted that it went out and came back. All who felt it testified that they were pushed down by the air. No evidence of vertical earthquake or fissuring was noticed or is recorded in the phenomena of the surrounding country. The buildings, bridges, and earth embankments within a mile of the zone of disaster show no disturbance. People similarly located testify that there was no earthquake. Is there any other explanation of this force than explosion?

Exhaustion of Air.—Many witnesses on the perimeter of disaster testified that they were not suffocated by ashes or detectable gases, "but could get no air to breathe." This language, or words to its effect, is the testimony of every witness, from the intelligent ship officers to the humble negro or peasant. Engineer Evans stated that he could get no air to breathe on deck after the explosion until he got below.

Foreman Evans, of Raibaud estate, said: "It was not hard to breathe until all was nearly over; then we felt as if we could get no air."

Noises.—Evans insisted that there was no noise at all when St Pierre was destroyed, other than a deafening roar. Some describe hissing noises like roaring silk. I have heard no evidence of a resounding explosion, but the testimony concerning noises was not thoroughly inquired for.

Conflagration.—All witnesses testify to the sudden and instantaneous conflagration of the city. Father Alte Roché noticed that it swept rapidly from north to south. In parts of the city all combustible material was destroyed, but in the center and southern parts many trees stand which were only singed of their leaves and twigs.

Duration.—The whole catastrophe, from beginning to end, was over in less than three minutes, although the ruins are still burning.

Succeeding Rain of Mud and Pumice.—Immediately following the destruction there was a rain of mud, or, as a negro witness stated, wet met the ashes in the sky, turned to mud, and it fell to the ground. This mud plastered all objects upon which it fell as with a thick coating of cement—houses, ships, and heads of human beings. The landscape was everywhere coated with an envelope of this warm liquid from the sky. This rain of mud continued for one-half hour after the explosion. The rain of mud is strongly suggestive of the condensation of the volcanic steam of the eruption in the air as a source of the moisture. H_2S, ignited, moisture from the combination of the H_2 with the O, may have theoretically also resulted.

Accompanying the rain of mud was a shower of pumice-stone. These stones were undoubtedly those which had been thrown higher into the air from the explosions than the other ejecta, and which with a long trajectory came down last. These stones or those of the eruptions, falling on the soft plastering of the landscape, rolled down the hillsides, striping the plaster with their parallel paths as if it had been raked with a coarse comb.

Death.—Death was an accompaniment of any of the phenomena of the eruption described, and undoubtedly occurred in many ways and in different degrees of suddenness. Many were killed by inhaling hot lapilli, notably on the *Roraima;* others burned by same on the *Roddam;* others burned by steam; others killed by force; others singed by flame. All did not die instantly.

Nearly all burns of the wounded survivors from the ship, according to Dr Riley, were of the first degree, affecting only the epidermis. There were also some burns of the true skin. The eyes of the wounded were unaffected and the eyelashes intact; on the other hand, remains on shore were horribly burned to the quick.

Officer Scott, of the *Roraima*, tells of children who moaned for water, "unable to swallow because of ashes which clogged their throats." "One rinsed out his mouth, but could not swallow on account of ashes which burned his throat."

It is not true that all the inhabitants died from asphyxiation in the position in which the cataclysm surprised them. Many were found in positions indicating flight and search of shelter. The captain of the *Roddam* told me he saw people running about the water edge for several minutes. In St Vincent it is said that a man was found dead in the act of twirling his mustache; another with his hand holding his pipe. An eyewitness told me that he saw in St Pierre a man holding a struggling, frightened horse, both dead in this posture. The man running the donkey on the *Roraima* was killed instantly where he was sitting; he never moved. Another person, a foreman, was standing by, holding the handle of the pump, when killed; and yet near by a child and nurse were only burned, and recovered. It is also stated a man who died on the *Roddam* was burned internally.

EXTENT AND PHENOMENA OF DEVASTATION

The effect of the preceding eruptions of May 3 and 5, and of the eruptions which have taken place since the day of the great catastrophe, notably that of May 20, all of which occurred within the same general district, are so intermingled that it is difficult to distinguish them.

The Area of Devastation as seen by me between May 20 and 30 represents the effect of all of these eruptions. As a whole, this area includes all the country between Carbet and Precheur bounded by the north and south cliff lines previously mentioned in the description of the configuration as constituting the amphitheater of death. This area practically includes the country between the Rivière Mouillage on the south and the Rivière Blanche on the north, with the addition of two coastal prolongations seaward of the cliff lines, which bend southward of the Mouillage toward Carbet and northward of the Blanche toward Precheur.

The Mud-plastered Landscape.—The whole of this area, both the included valley and the faces and summit edges of the escarpment, is enveloped in a smooth compact casing of mud plaster, resembling a coat of cement, which is striped by parallel erosion scratches which have scored the surface. This cement covers a well-defined zone, representing the area of the catastrophe, the shower of mud following the ignition cloud. It may be noted that pouzzioloni, a natural cement, made from volcanic material, was about the only economic product of Martinique's geological formations, and was extensively found around St Pierre.

Between the mud rivers south of Precheur and the Rivière Mare the coast line bluffs. Along this bluff extends the remains of what was once a magnificent and costly highway. Its macadamized surface is now covered to a depth of three feet with mud, and obstructed here and there by fallen trees. In the mud there are numerous bodies of animals, cattle, horses, and donkeys, with occasional human remains.

Destruction of Habitations.—All the homes of the 25,000 people of St Pierre are destroyed. Outside of St Pierre, in the area below the cliff line, there is not a visible sign remaining of one of the homes of the 15,000 people who inhabited them. Annihilation is the only descriptive term. While remnants of houses remain in St Pierre, the annihilation extends northward to one-half mile of Precheur.

Among the country places destroyed around St Pierre, according to M. Houly, were the following: Perinelle, Pecoul, Reduis, La Trois Points, Jardine des Plants, the Bishop's house, L'Habitation, Trouvallon, Miron, Tricolore, Lance, La Touche.

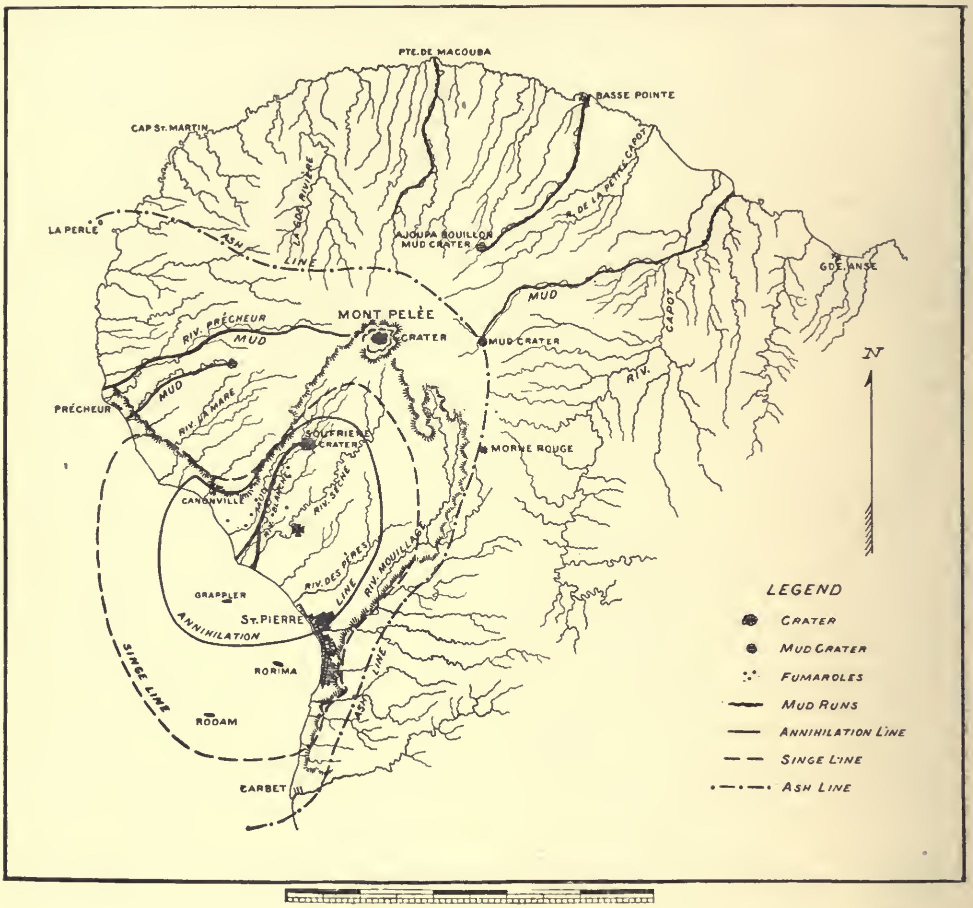
Denudation of Vegetation.—Over this entire area the vegetation is entirely denuded, with the exception of a few larger trees standing in St Pierre, from the Mouillage southward, stripped of all leaves and twigs and bark, only the trunks and larger limbs remaining. On the edge of the cliff above St Pierre, several large trees with foliage singed remain standing in the area of mud.

In the gradients of the deep valleys of the headwater ravines nearest the summit, on the St Pierre slope, trees of the *grandes bois* still stand with foliage untouched. In protected lateral ravines of the south cliff, near the Jardin Botanique, bamboo and other vegetation was still green, while killed on exposed hillsides above them.

The vegetation on the summit of the south cliff to an altitude of 100 meters was killed; in the deep valleys of the stream entering the sea at the south end of St Pierre, cane and grass were not affected.

Along the coast benches vegetation was blasted as far south as the northern edge of Carbet village. In the south edge cane and palms are green. To the north the coast cliff as far as the first stream, one-half mile south of St Pierre, is also denuded and blasted to an altitude of 200 feet or more. Nearer Precheur dead trees and palms are broken down three or four feet from the ground and lie to the westward.

Ash (Lapilli-covered) Zone. — The whole of the island has received a



Map Prepared by Robert T. Hill Showing Zones of Devastation in Martinique

sprinkling of lapilli from the aggregate eruptions. This is not conspicuous or discoloring, however, except within an area a mile or two beyond the mud-coated area and over the latter. The quantity and extent of ashes erupted cannot be estimated, nor is it material at present to do so.

Mud Rivers in the Devastated Plain.—The Rivières des Peres, at the northern limit of the city, and the Seche, within the amphitheater, have been the sites of mud torrents from the eruptions.

The coastal extension of these streamways is so filled with mud that their former valleys are filled up level with the low divides, so that they are practically obliterated. What was the lower valley of the Rivière Blanche for a mile back from the sea is so filled up that now it is a convex elevation near the sea, built up by successive mud flows, so that streams of the latter run down from it into the Seche.

The Rivière Blanche is still flowing mud in intermittent gulps from the lower crater of L'Etang Sec. To the northward there are conspicuous mud streams near Precheur, presumably from the hot springs above that town, but it is not proven. Other mud rivers outside the area of devastation are elsewhere mentioned.

One mile south of Precheur there were two small canyons, in the bottom of which were two flowing streams of viscous liquid mud coming down with sluggish movement, choking out the small narrows within the banks and then suddenly starting forward again with a horrible gulping noise. In this mud were many small pieces of pumice.

Beside the mud delta forming the level at the mouth of the Rivière Blanche, there are many great boulders of pumice on the adjacent level, brought down by the preliminary eruptions of water. The old mouth of the Rivière Seche is filled with these bluffs.

New-built Land from Sedimentation.—Off the mouth of the Rivière Blanche the sea border is extending from the deposited mud. A small islet, 50 feet long, 10 feet from the shore, has appeared above the water to the north of the mouth of the Blanche, composed of sedimented mud and fumarole deposits.

Wave-cut Bights.—From St Pierre to Precheur there are many small triangular bights in the beach and enlargements of the mouths of streams cut by the force of the return wave.

The mouth of the Rivière Mare has been deeply incised and presents vertical new cut bluffs, some 20 feet in depth, which render the crossing of it impossible.

The movements producing these bights consisted of an outer motion of the water from the shore and a return wave. They were caused by explosion within the air and not by any movement of the bottom of the sea. The waves were observed at Fort de France.

It was reported from St Lucia that there was a strange commotion in the sea, as if the waters were boiling over a large area, as located with a range-finder from Castres, on the 7th and 8th, as if two waves had met. This report lacks verification.

Changes in the Summit.—It is rumored that toward the north the crater rim has broken down, and that Morne La Croix of the southwest rim has gone. Admiral Servan informed me that several officers had measured the altitude of Pelée and had found that it had lowered 60 meters by the destructive explosions. The Lake of the Palmistes is gone, while in the old bowl of the crater, through the great gap in its western side (which was there in 1823), may be seen a great pile of pumice, over 100 feet in height.

New Geological Formations Made.—With the exception of the new addition to its soil of layers of mud and ashes, the filling in of the lower streamways of the rivières of the amphitheater of disaster, and on the east and north side the fringing load of sediment along their mouths, and the new pile of pumice around the summit vent—new formations added to the mother pile—no other positive topographic changes have taken place in Martinique.

Topography Unaltered. — Otherwise the configuration of Martinique today shows no serious change. Every hill, valley, scarp, precipice, or other surface feature of the relief as laid down upon the map of 1823 is distinctly recognizable. The changes are merely the superficial destruction of vegetation and the veneering of a small triangular area with a thin layer of ashes and mud, so that it is converted from a green carpet of cane and wood land to a barren, desert mountain landscape like that of Arizona.

Small Proportion of Island Affected.—*Nineteen-twentieths of the area of Martinique is as green and beautiful today as it ever was.*

Of the total area of Martinique, about 380 square miles, only 12.5 square miles have been seriously affected by the eruption. This area principally embraces a triangle between Carbet, Pelée Peak, and Precheur village.

No Lava Flows.—There have been no lava flows whatsoever, nor, owing to the mineralogical character of the rocks, would these hardly have been probable. The solid ejecta from the mountain have consisted of lapilli and blocks of pumice, together with some of the old crater material of previous eruptions. No true bombs have been ejected, nor molten rock in any form. Incandescent stone or pumice has been blown from its top at times and fell in showers immediately around the crest, as was witnessed by Mr Morse, of the *Herald*, and the writer, on May 25; but this quickly cools upon reaching the air, and cannot be called lava.

No Subsidence or Uplift of Land or Sea Bottom.—There has been no subsidence or elevation of the land that can be recorded, nor of the adjacent sea bottom. The little rock of La Perle, a half mile off the north coast, stands there today as it did when I first saw it, five years ago; the unmistakable bench-mark of elevation or subsidence—the horizontal groove cut by the surf line in the base of the cliffs—is everywhere as it was, sprawled over by the same spray-living mollusca and beds of algæ.

The only change in the littoral are the vicious little bites into the banks and the mouths of the rivers made by the return wave at the time of the great eruption.

No Fissuring Earthquakes.—Neither have there been any serious or positively proven earthquakes resulting from the rending of the earth along fissures. Within a mile of St Pierre the bridges, roads, houses, and trees stand unshaken. Eyewitnesses testify that they felt no quaking, only a force in the air which tended to knock them over. On the other hand, there have been jars and tremors from the tremendous explosions within the mountain, and these were of sufficient force to break the cables.

Measured by the geological standard, only a new formation has been made by a passing event in nature's workshop.

Has nothing happened? Ask the 30,000 mouldering dead, the sixth of Martinique's population, which moulder beneath the ashes of St Pierre.

THE VOLCANO

In describing the effects and phenomena of the eruptions, I have almost forgotten the Hamlet of my story—the volcano which has caused the trouble. Across the weird landscape from the summit of Pelée the volcano still sends forth its occasional bursts of steam and cloud, rising in great mushroom clouds to 15,000 feet above the sea. At night these are vivid with lightning flashes and streaks of igniting gases.

Within the summit bowl that existed before the present eruption one can see plainly through the broken nick a newly built-up pile rising a hundred feet or more and largely composed of tremendous blocks of white pumice-stone which have been thrown out and accumulated in the old vent. Through these are seething wreaths of escaping steam.

Down the dreary western slope, up the valley of the Rivière Blanche, where it is lost behind the hills, one can see the smoke from another vent some 3,000 feet below the summit and not over two miles from St Pierre. When the summit sends up its great seething mushroom clouds, which float away, from this lower vent may be seen another and flimsier puff of yellowish hue which lingers near the ground. In all the eruptions that I witnessed the columns from the top of the mountain ascended, while the smoke from the lower vent of the western slope floated off horizontally or followed the contour of the land toward the sea.

Still nearer the sea an inky-black river of mud follows the Rivière Blanche to the sea. It does not always run, but occasionally near its head great fountains of mud shoot in the air, and then the stream flows down with a single gulp.

Somewhere on the hills above Precheur there is another mud fountain, presumably at the Bains Chauds. This sends its mud down to the coast through a little stream near Precheur.

Over the dreary mud plain of the Rivière Blanche, on the margin of the sea, and upon a little islet in the sea at the mouth of the Rivière Mare, are dozens of fumaroles, each an active little steam jet sending occasional puffs into the air.

Around on the northern slopes of the mountain near Ajoupa Boullion, on the road from Basse Point to Morne Rouge, there is another mud vent which flows great streams of that material down to Basse Point, which is slowly being buried beneath it. Still to the eastward is the mud crater of the La Falaise. The latter is situated to the east of the summit, and was first seen by Mr Clerc the same date as the explosion of May 20, although it may have existed some time before. It occurs in the bed of the river itself, and while the river still flows below it, it has ceased flowing above. The water of the river is boiling and full of mud.

The dates at which these mud eruptions began cannot be stated, nor is it material, further than to say that most of them were from old thermal sources which had long been known to exist upon the island, and that they were a part of the same general phenomena of an ascending molten column of magma beneath the dome of Montagne Pelée, which, upon coming in contact with the earth water, was converted into lapilli, at the same time changing the water into steam, which forced the combined product of the steam and magma (mud) up old vents which have probably existed from time immemorial.

Clouds of lapilli and steam were noted on April 25 coming from the summit crater, and on April 27 molten matter was observed in the lower crater, L'Etang Sec, midway between the summit and the mouth of the Rivière Blanche, on the western side. These clouds of eruption occurred intermittently, with increasing size and magnitude, until May 8, the date of the great catastrophe, and are still continuing at frequent intervals, the reports having announced similar eruptions as late as June 20. About May 1 the streams radiating out from Montagne Pelée began to increase in volume, and their waters were darkened with lapilli. On May 3 a great torrent of liquid mud flowing down the Rivière Blanche showed that the mountain was erupting mud as well as lapilli and steam. The intense odor of sulphur which permeated the landscape also showed that sulphurous vapors were being ejected.

The volcano has continued working since the deadly eruption on the morning of the 8th of May, just as it had been working before. The volcanic forces continue to exhibit themselves, and are probably still in operation at this writing. There is no complete record of the eruptions. Only those which send a cloud over Fort de France, or which are observed by visitors to St Pierre, are noted.

On May 12 a great black canopy of smoke continued to rise from Mont Pelée, and spread out over the sky to the horizon, causing darkness even in the middle of the day.

On the morning of the same day, at 11.30 a. m., a cloud of smoke rolled down north of St Pierre into the sea, and was witnessed by the people on the tug *Potomac*. This cloud was timed, and came down the mountain about two miles in three minutes, and was witnessed by the people of the *Indefatigable* and the *Potomac*. Mr Richard Kalisch, an eyewitness, showed me photographs of this cloud from which I made a sketch.

The most serious recurrence of eruption was on the afternoon of May 20, about 5.15 a. m. A cloud floated over Fort de France and caused an exodus of the people from that city. This eruption of Monday, according to Engineer Evans, who was in the hospital at Fort de France, lasted until daylight, and was accompanied by many detonations. Showers of stone the size of a hen's egg fell upon the hospital. The falling sounded like hail, and tore the leaves from the trees. These stones, as I ascertained by personal collection the following day, were old crystalline rock of the mountain and not pumice.

Victor stated that this eruption of May 20 was accompanied by total darkness over his point of view, Deux Choux, after a great explosion of flame, one-half of which went up to heaven and the other half toward St Pierre, just as the clock was striking 5 a. m. Lieutenant Gilmore, executive officer of the *Cincinnati*, who is so well known to the American people by his experience as a prisoner among the Filipinos, saw the cloud which rolled over Fort de France. He states that the stones which fell on the deck of the *Cincinnati* were so hot that they burned the awnings on the cutter. These came down like hail. Lieutenant McCormack, of the *Potomac*, stated that a slight wave surf following the eruption was felt in the Bay of Fort de France on the 20th of May, making a peculiar roll of surf. He also estimated that the fall of ejecta averaged 376 tons to the square mile.

According to many, this eruption still further destroyed St Pierre, leveling the remaining walls almost to the ground and burying the dead in the streets beneath a new shower of lapilli. A self-recording barometer at Fort de France also made a notch at the time of this explosion.

On May 25 I witnessed a frightful summit eruption from Fond St Denis. This was accompanied by lightning effects and what I believe to be the ignition of gases. An account of this eruption was described in the New York *Herald* of Sunday, June 8, by Mr Morse.

May 29, at 8 p. m., while on board the French steamer, the captain of the French steamer *D'Assas* came aboard and told Admiral Servan that he had just witnessed an overflow of incandescent lapilli from the crater rim.

On May 30, at 1.45 p. m., the cable *via* Puerto Plata broke again. Almost simultaneously vast quantities of mud flowed out of the northern crater and torrents of it invaded the plateau of the Vive plantation. This was the last bit of news I received on the *Dixie* from Consul Ayme as we weighed anchor for the United States.

Reports of eruptions have continued up to the last few days, and will probably continue for an indefinite time, until Pelée's vents once more clog up and the surface manifestations gradually diminish until the mountain sleeps again.

CONCLUSIONS

THE GEOLOGICAL LESSON

It is now evident that the destruction of St Pierre, viewed from a broader standpoint than human disaster, was but an episode in a group of general phenomena constituting the 1902 eruption of Montagne Pelée, and that the eruption of 1902 is but an episode in a series of events which have been taking place through long epochs of geologic time. Let us, then, forget, if possible, for a moment, the great catastrophe, and consider the phenomena as a whole.

1. That Montagne Pelée is one of the chain of ancient volcanic mountains, dating from Tertiary time, rising to a height of 10,000 feet above the ocean bottom along the interior side of the semicircular ridge across the entrance of the Caribbean Sea.
2. That the volcanoes of this ridge have been successively forming on its western side.
3. That the material, like that of the Cretaceous volcanoes of the Great Antilles, is entirely andesitic.
4. That the eruptions, especially of the later periods, have all been of the explosive type, unaccompanied by lava flows.
5. That the historic eruptions have taken place between long intervals of solfataric quiescence.

The geology of Martinique, as outlined, shows that Pelée is an old volcano, and that the present eruptions, instead of being sudden and a new phenomena, are but the maximum of a series of solfataric conditions which have continued through a long interval of geologic time. The eruption of 1851 produced similar phenomena of ash, mud, and steam ejected from the same vents, and affected a similar area. The geological structure of the mountain of Pelée shows, in its layers of mud, pumice, and tuffs, that these processes have been going on at long intervals from time immemorial. The first important deduction, then, is that the present eruption of Pelée is the repetition of events which have taken place time and time again at the same locality, and that the mechanism of the volcano is all old and prehistoric—the same central crater and lateral vents. So far as recorded, the volcanic mechanism of Pelée is the same as it was at the date of its discovery in 1894. No new craters have been formed, but merely old craters reopened. The principal feature of this mechanism is the crater of Montagne Pelée—simply a conical chimney leading from the hot magma of the earth and built up of its own ejecta. This chimney is a vertical tube extending downward to the interior magma, which ascends as a great column of molten matter. The bowl or crater of Pelée summit is the top of the chimney.

FEEBLENESS OF THE PHENOMENA

The fact that there were no serious earthquakes shows that the explosions within the crater were not exceptionally severe ; in fact, not as severe as many which have taken place within the Antillean vents, with deadly earthquake effects, without causing eruptions. No evidence has yet been deduced showing that the present eruption was preceded by or has resulted in any serious openings or fissures in the sea bottom, which could have caused it by the sudden letting in of the waters; neither is there, in the structure and geographical position of the oceanic Caribbee Islands, any condition which enables us to hypothesize a deposit from sedimentation which would produce weight resulting in the creation of such fissures.

The conical configuration of the mountain ; the repetition in geological time of the eruptions at the same locus ; the absence in the structure of the island of conspicuous volcanic dikes and sills ; the failure of other and more conspicuous solfataric vents along the Caribbee chain to erupt, indicate that the shape of the ascending magma is cylindrical rather than elongated, as would have been the case had it arisen along the fissure.

The eruption of 1902, which is still in progress, has been one of progressive intensity for an unknown period of time. The waters of the L'Etang de Palmiste in the top of the crater bowl have been warm for several years, and as far back as May, 1901, sulphurous fumes and vapor were noticed escaping. Conspicuous activity suggestive of intense eruptivity was first observed in the middle of April, 1902. These phenomena were at first slight tremors which shook the dishes on the shelves in the house of Mrs Prentiss, wife of the American consul at St Pierre, and which were undoubtedly produced by the first audible explosions within the mountain from the ascending column of magma coming in contact with moisture.

RELATIONS TO THE ERUPTION IN ST VINCENT

The synchronism of this eruption with that of St Vincent, a hundred miles distant, and volcanoes of a similar explosive andesitic character in Central America, to say nothing of disturbances reported in volcanic area throughout the world, is strangely, almost positively, suggestive that the cause of the eruption of Pelée was not the development of a local fissure suddenly letting the water of the sea down to the depths of the hot magma, but, upon the contrary, resulted from a widely occurring disturbance within the interior of the earth's magma, which caused it to rise to meet the upper wet zone; rather than the water of the latter to descend to it, and which is as yet inexplicable.

IMPORTANCE OF ELECTRIC AND MAGNETIC PHONOMENA

Finally, accompanying this eruption were phenomena, electricity, magnetism, and gases, which, while not probably occurring for the first time, have been conspicuously brought to our attention, and may lead to important deductions upon the origin of magnetic storms and the nature of the earth's interior.

RESUMÉ

The 30,000 people of St Pierre were exterminated within a few minutes and the town set on fire by the sudden eruption of a volcanic cloud.

The fatal cloud came from the lower vent, two miles north of the city.

The vapors coming from the volcano were and are sulphurous.

There was force accompanying the eruptions of the morning of May 8 of great destructive nature, which left much evidence that the gases within the cloud exploded after having reached the air.

The summit eruptions were and are accompanied by tremendous electric (lightning-like) phenomena.

A great magnetic storm accompanied the eruptions of May 8, which was recorded at remote points, and which indicated a connection between them and the volcanic eruptions.

In connection with the magnetic phenomena, it is of interest to note that Poey has presented a table showing the relation of Antillean earthquakes and eruptions to the period of sun spots. Of 38 seismic tempests in the Antilles, 17 occurred near the maximum sunspot epochs, and 14 near the minimum. Those of 1846, 1851, 1852, and 1853 were found midway between. The maximum number of volcanic eruptions occur at the minimum of sun spots, and *vice versa*.

There is some evidence that flame is emitted with the summit explosions.

All the evidence indicates that the fatal explosions were not from the site of the old crater, which is five miles distant from St Pierre. All the circumstantial evidence and much of the direct strongly indicate that the destruction was caused by the eruption from the lower vent, about two miles above the mouth of the Rivière Blanche and some distance north of the city.

CHOICE OF THEORIES OF THE CATASTROPHE

The foregoing data and essential facts concerning the great catastrophe I have not attempted to interpret, nor do I wish to obscure the understanding of the events by individual interpretation and hypothesis. Nevertheless, it may not be presumptuous to suggest that conflagration, death, and fatality in St Pierre may ultimately be explained by either of two theories:

1. The heat-blast theory. This hypothesis assumed that the lapilli, gases, and steam of the ejected cloud were sufficiently hot to have inflamed the city and destroyed the people by singeing, suffocation, and asphyxiation. It does not account for the forces exerted radially and horizontally, nor the flame.

2. The aërial-explosion theory. The explosion of gases within the erupted cloud after their projection into the air would account for all the phenomena observed.

The aërial explosion, if it occurred, was most probably a combustible gas, but science is still unable to state its nature. The discussion of explosive gases involves a line of scientific specialization which the writer does not possess; but as sudden and mysterious as was the great secret it has left its traces and clues which the detectives of science will follow up. Metal surfaces of objects in the ruins will be examined and analyzed for traces of sulphur and chlorides. The deposits from the numerous steaming fumaroles are already within the chemical laboratory. Even the ash and rocks of the island will be submitted to minute investigation.

And then there were those frightful lightning bolts! What of them and their igniting power?

THE RECENT VOLCANIC ERUPTIONS IN THE WEST INDIES

A Letter to the National Geographic Society

By Israel C. Russell

TOGETHER with Robert T. Hill and C. E. Borchgrevink, I had the honor to be a member of the commission sent by the National Geographic Society to examine the results of the recent volcanic eruptions on the islands of Martinique and St Vincent. Owing to the courtesy of the President of the United States, we were enabled to accompany the U. S. S. *Dixie* on her mission of relief to the stricken islands. The *Dixie* was in command of Capt. R. M. Berry, U.S.N., and as one of my primary duties I wish to convey my thanks to him and his able officers, and especially Lieut. Comdr. F. A. Wilner and Lieut. J. B. Bernadou, for their genial hospitality and never-failing desire to assist in our work.

The *Dixie* sailed from Brooklyn on the evening of May 14, and after a pleasant voyage reached Fort de France early on the morning of May 21. The time spent on the *Dixie* was most enjoyable. Among our companions were Dr T. A. Jaggar, of Harvard University, and Dr E. O. Hovey, of the American Museum of Natural History, who, like the commission sent by the National Geographic Society, had in view the study of the recent volcanic eruptions. The relief stores sent by the United States Government were in charge of

Capt. J. J. Gallagher and Capt. R. Sewall, of the Army. Connected also with the relief expedition were Lieut. J. B. Clayton, Lieut. J. R. Chusch, and Lieut. J. Riley, assistant surgeons, U. S. A.; Sergts. J. P. Edmunds, W. H. Thomas, and four privates belonging to the hospital corps of the army. With the *Dixie* went also a number of correspondents for magazines and newspapers and several photographers and artists.. The *Outlook* was represented by Mr George Kennan, the *Century* by Mr G. C. Curtis, *McClure* by Messrs A. F. Jaccaci and G. Varian, *Harpers* by Mr S. C. Reid, *Leslies* by Mr G. B. Lucky, and in addition some fifteen of the leading newspapers of the United States sent able and experienced correspondents. In the list of passengers were also included the names of Mr G. de Medeuil and Chas. Van Romondte, citizens of Martinique, who had suffered severe bereavement and financial loss in the destruction of St Pierre and who kindly furnished many eager inquirers with details concerning their native isle.

ON BOARD THE DIXIE

The expedition sent on the *Dixie* was unique in several ways. It is greatly to the credit of the Army and Navy that the vessel could be coaled, loaded with 1,265 tons of relief stores, and sent rapidly gliding toward the stricken islands in the West Indies in the space of about four days. As an illustration of the spirit of sympathy and love for all mankind fostered by our great Republic, the relief expedition sent on the *Dixie* and all pertaining to it can be looked on with pardonable pride.

The voyage of the white cruiser on her mission of mercy was memorable also for the unprecedented assemblage on her decks of travelers and explorers who had visited and were familiar not only with the well-beaten highways of the world, but many of her most remote and difficult byways. Each afternoon informal lectures were given by some one from among the passengers for the benefit of the sailors, who gathered about with eager faces to learn from Hill of the beauties and mysteries of the West Indies, to travel with Kennan over the trackless snow and witness the marvelous auroras of Siberia, or explore with Borchgrevink the desolate wilds of the Antarctic continent. Walking from group to group on the deck, as the good ship glided southward, especially during the moonlit evenings, one could catch fragments of well-told narratives of life in the most remote corners of such countries as Russia, India, and Corea; or of the Philippine and Cuban campaigns and the entry of Americans into the Forbidden City. Some of our number had but recently been in Africa, and told of experiences on the firing-line of each of the contending armies in the Boer war. Others spoke of wild life in Alaska, Indian campaigns in Arizona, studies artistic or scientific in Australia, New Zealand, Hawaii, Samoa, and other places, some bearing names made familiar by recent writers in history and others so remote and wild that the general public knows not of their existence. I can truthfully say to the generous members of the National Geographic Society, that their representatives on the *Dixie* found themselves in a congenial atmosphere, and amid surroundings most stimulating to them as representatives of a great society, whose grand aim is to lead the inhabitants of the world to know the marvelous wonders of their dwelling-place.

On the morning of May 19 we passed low-lying Sombraro, a fragment of a flat, calcareous platform, and a little later sighted the island of Saba, the most northern of the volcanic Caribbees. The latter island is the summit portion of a volcanic mountain, built principally about a central crater, but judging from distant view, at least two lower craters are still distinguishable. Later, we passed in succession St Eustis, St Christopher, etc., and as the curtain of the tropical night dropped over the wonderfully blue sea and cloud-capped islands were to the westward of Guadeloupe. I may remark here that all the islands of the volcanic Caribbees which we saw, including Martinique, St Lucia, and St Vincent, on which we landed and made more or less extended examinations, reveal in their topography the results of long erosion by heavy rains and swift, high-grade streams. The bold constructional forms of the original volcanic piles can frequently be distinguished—the rude blocks, as it were, from which the agencies of erosion have sculptured varied and bold but graceful forms. Stream erosion is the leading story recorded in the surface contours. Deep, narrow, steep-sided valleys radiate in all directions from the dominant peaks, and between them are blade-like serrate ridges. At first the topography has an unfamiliar appearance, owing to the universal mantle of luxuriant, emerald-green vegetation, but the eye soon penetrates the mask and sees the cliffs, jagged crests, and monumental forms of the rocks beneath. The islands visited are composed mostly of ejected fragments, or tuffs, interbedded occasionally with sheets of compact lava. The many and abrupt variations in the resistance of the rocks—resistance not only to the mechanical corrasion of streams, but the chemical action of warm water charged with the products of vegetable decay—find expression in the minor serrations of the thousands of sharp-crested ridges radiating from the higher peaks in all directions, and in the cliffs facing the sea. Each headland is truncated, and in many instances the progress of the ocean's waves in eating away the land is recorded by outstanding rocks and seemingly inaccessible foam-girted crags. An example of such a monument recording the former extent of the land is furnished by the historic Diamond Rock, off the south coast of Martinique.

The Lesser Antilles lie in a well-aligned chain or necklace, as our Hill has poetically termed it—unfortunately a broken necklace, when considered politically—which extends athwart the flow of the never-ceasing trade winds. The eastern shores of the island are dashed against by tireless waves. On that side the emerald of the enameled lands is divided from the glowing sapphire of the sea by a fretted band of silvery surf. On the western side of the islands the waters are usually still or broken by white-crested waves that travel away from the shore. The rise and fall of the tide is small, averaging on the headlands perhaps two feet, and for this reason the work of cutting a shore terrace is retarded. The work of the waves in modifying the coast line is most conspicuous on the side facing the trade winds, and on the eastern shore most instructive examples of towering sea cliffs, stretches of wave-smoothed beaches, and piles of wind-driven sand hidden beneath verdure attract the eye. On account, principally, of the heavy surf on the eastern side of the islands, the best harbors and the most important towns are on the Caribbean shore.

While the stars were yet scintillating in the sky on the morning of May 21 we passed southward a few miles offshore, where St Pierre lay buried beneath its pall of gray dust. As we learned later, a terrific explosion of Mont Pelée had occurred the day previous, and a second blast of dust-charged steam had swept over the dead city. Vast vapor banks shrouded alike the terrible volcano and the silent victims at its base. A few smoldering fires were visible where the once beautiful city had been, but her lighthouse was in ruins. The seeming signals were the sullen glow of her last smoldering embers.

IN THE RUINS OF ST PIERRE

The day was yet young when the *Dixie* paused in her rapid flight and dropped an anchor in the spacious harbor of Fort de France, ready to send her relief store to the sufferers on shore. Salutes were fired, official calls made by the commanders of the several warships at anchor in the harbor, and in an hour your commission was on the U. S. dispatch boat *Potomac*, traveling rapidly northward along the beautiful western shore of Martinique toward St Pierre.

But slight evidence of the considerable showers of dust and lapilli that had fallen on the island during the previous day was visible. Headland after headland was passed, each the truncated end of a sharp-crested ridge leading up to the vapor-enshrouded summit of Mont Carbet. At the mouths of the narrow, high-grade valleys red-roofed houses, villages with tapering church spires, and thrifty plantations were embowered in palms and other trees which grow densely and fail to reveal their identity at a distance.

On nearing the now widely known village of Carbet a distinct gray tone to the previously universal green of the hills told that we were nearing the source from which came the showers of dust that had fallen on the island. Soon the withered and yellow crowns of palms revealed the touch of the hot breath of Mont Pelée. Beyond a desolate ridge, steam in large volumes was rolling upward in fleecy wreaths, and beyond could be seen the gray, blasted western slope of the dreaded volcano. Rounding a promontory, the desolate, silent shore was in sight, where St Pierre but a few days before was embowered in beauty; but the eye must needs be strained or field glasses used in order to distinguish the outlines of gray ruins against the neutral background of barren cliffs where once grew the fairest gardens of the West Indies.

The *Potomac* steamed into the roadstead in front of St Pierre and was made fast to a buoy. Boats were lowered and quickly filled with men eager to study in various ways the evidences of disaster. The gallant commander of the *Potomac*, Lieutenant McCormick, every inch a sailor of the new school, gave command that all who went ashore should return to the boats when a blast from the tug's whistle should summon them, and that no one should bring off objects of value from the ruined city. I take pleasure in recording that the second of these commands was obeyed as thoroughly as the first, and, as subsequent experience demonstrated, the first command was obeyed with alacrity. Our visit to St Pierre was repeated and our exploration of the ruins extended the subsequent day, but it is not necessary at present to be precise as to dates.

While rowing from the *Potomac* to the stone quays along the water front of the dead city, we passed the indefinite spars and some of the vessels that went down on the terrible morning of May 8. No attempt had then been made to raise the sunken ships, some eighteen in number. The ruined city lay before us—silent, desolate, and gray with volcanic dust. Not a person was in sight, and not a living thing was seen during our clamber over ruined walls and through deeply débris-filled streets except the members of our own company.

It is unnecessary at this time to attempt to describe in detail the scenes that met our view as we passed in silence over the dust and rubbish beneath which thousands of human beings lay buried, as this has already been well told in the daily press. We glanced aside on passing the grim remnants of what on the fair morning of May 8 were living men and women. We could not aid in the work of cremation, suddenly abandoned the day preceding our visit, by the second great eruption of Mont Pelée, and avoided, so far as pos-

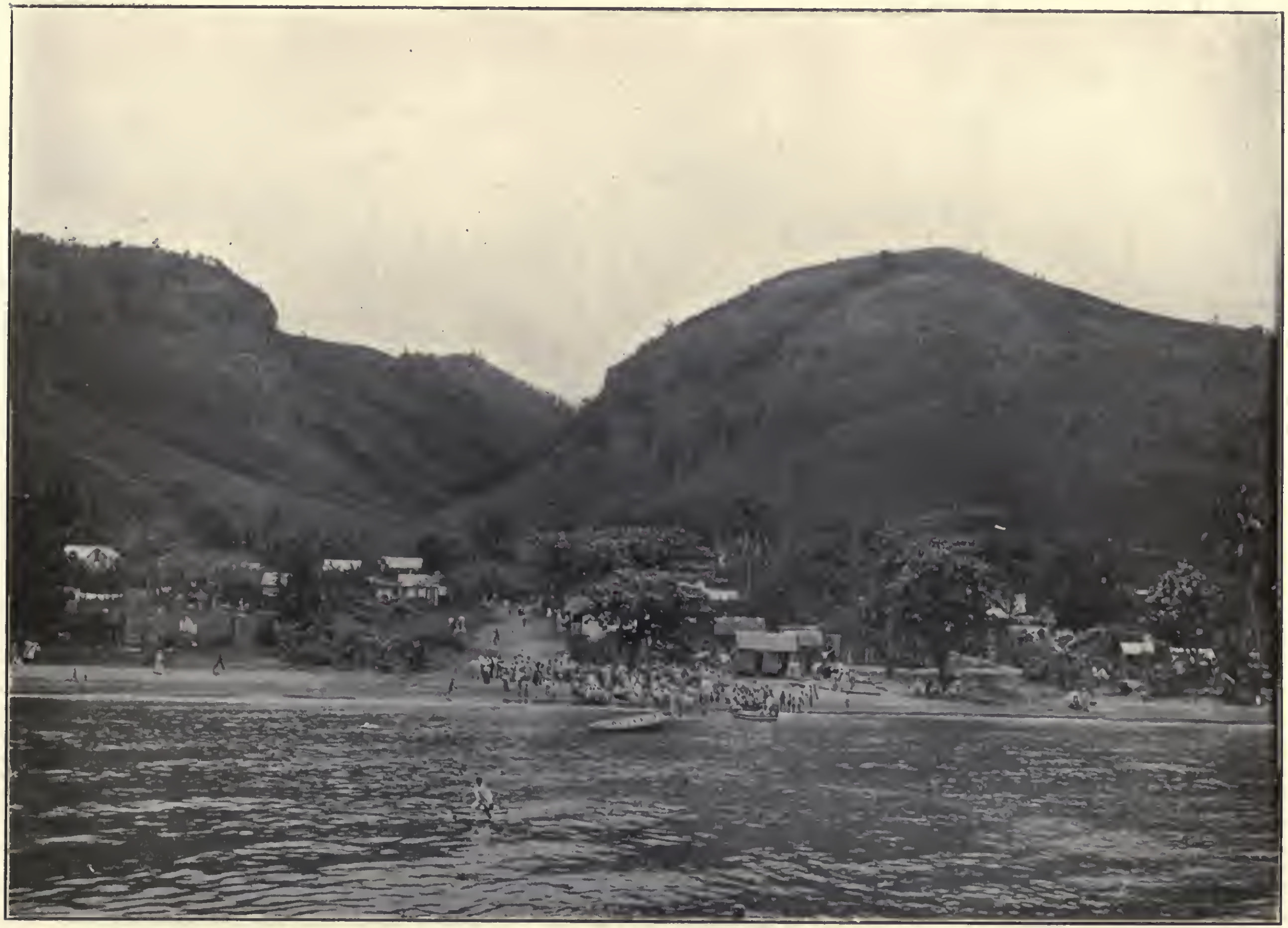


Photo by Israel C. Russell

Refugees on the Shore of St Vincent (*see page 275*) sible, the gruesome sight still lingering. On passing to the higher portion of the city, however, where the French soldiers had not as yet performed their sanitary work, the piles of dead could not be avoided.

The best general impression of the present condition of St Pierre can perhaps be obtained from the hill at the south end of the city, termed Morne d'Orange, where formerly stood a colossal statue of the Blessed Virgin. Near the vacant pedestal of the statue is the wreck of a giant cotton tree, its broad buttressing roots still anchored in the rocks on the verge of the hill, and its blasted branches lifted like appealing arms, heavenward. From beneath the deep shade of that wide-spreading tree eyes no doubt glanced over the peaceful city, with its red-tiled roofs and many tossing palms, on the morning of the 8th of May, followed the green slope of Mont Pelée to beyond the fields of arrowroot and cane, upward to the dense tropical forest on the summit portion of the awakening volcano, to where its hot breath condensed and mingled with the vapors brought by the steadily flowing trade winds. The person who last saw that fair picture—of blue sea, animated city, verdure-covered slopes, and the vast cloud-filled sky—on the morning of my visit, lay with many others—shriveled corpses—partially buried beneath the seemingly universal sheet of gray volcanic dust. The beautiful picture had been blotted out, all except the smiling sea and the rugged mountain. At my feet lay the dead city, silent and gray. Not a green thing was in sight. Not a tree was standing, except on the far-away mountain ridge leading down to the partially destroyed village of Precheur, and even those were scorched and withered. It is difficult to convey in words the appearance of an absolutely plantless landscape, but in that triangular space, some 20 square miles in area, on the western slope of Mont Pelée, there was not a thing left alive, and not a tree left standing after the volcanic blast swept over it. Fire followed the hurricane of hot vapor, and the rain of rock dust buried what the fire left unconsumed. Never before in the history of man has such complete destruction been wrought on an area of equal size.

Gazing down into the silent streets from the heights of Morne d'Orange, I could trace their course and see the irregular plain on which the city had been built, but no conspicuous objects were in sight. Even the cathedral was indistinguishable in the universal ruin. Farther northward, where St Pierre extended beyond the bold heights on the landward side, where formerly rose the royal palms of the botanical gardens, the depth of the deposit of gray dust was such that streets were obliterated and houses buried out of sight. The reason for the deeper covering of the northern than the southern part of the city is that the former was at the margin of a sloping plateau-like surface, leading toward Mont Pelée, down which the dust was swept and piled upon the houses; while farther south sheltering heights intervened and the area from which dust could be swept was much less extensive.

I feel, however, that you are already, from your reading, almost as familiar with the desolate picture which St Pierre and its surroundings present, but may wish to ask if it is true that all the destruction was done in the space of a few minutes, and how this exceptional event in the history of volcanoes came about. The evidence of eyewitnesses who were near the border of the devastated area or on the ships in the roadstead facing St Pierre is conclusive that the 30,000 people, as the estimate is, who perished with the city died within the space of perhaps three minutes. Indeed, it seems safe to say that probably the most of them met their death in less than one minute after the blast from Mont Pelée swept over the town. As to the precise nature of that blast, the members of your commission, I believe, differ in opinion.

It has been stated in the newspapers that the inhabitants of St Pierre were asphyxiated by noxious gases or killed by a gas explosion. My own observations and the best interpretation I can place upon the testimony of surviving witnesses favors the opinion that the general cause of death was a blast of steam charged with hot dust. Gases, probably in part inflammable, were no doubt present, as the odor of sulphurous acid was perceptible at the time of my visit; but the part that such gases played was seemingly secondary. In order to be able to judge of the conditions where everything was destroyed, it is necessary to learn what took place on the outskirts of the storm. The people on the borders of the devastated area who escaped were in some instances injured, and the injuries were inflicted by hot dust, which on touching the skin adhered and burned. These burns resemble scalds, and destroyed only the epidermis. In several such instances the hair on the burned portions was not destroyed, and where the bodies of the sufferers were protected by even light clothing they were uninjured.

Had the dust which struck the injured people been somewhat hotter their clothing would have been ignited, and if they had inhaled the hot dust death would have been almost instantaneous. The condition of the dead in St Pierre favors the conclusion that this deduction shows what there took place. While the inhalation of steam charged with burning hot dust may seemingly be accepted as the principal cause of death in the stricken city, it must be admitted that many persons were no doubt killed by falling walls, by nervous shock, etc.

The blasts which swept St Pierre on the morning of May 8, and again on May 20, passed through the city with hurricane force. This is demonstrated by the manner in which great trees were uprooted, strong masonry walls thrown down, the light-house overturned, etc. The direction in which all these objects were swept was a little west of south, or directly away from Mont Pelée. The most conspicuous evidence of the strength of the blast which wrought the mechanical destruction is furnished by a statue of the Blessed Virgin, referred to above. That statue, composed, I understand, of iron, and measuring over 11 feet in height and nearly 10 feet in circumference at the shoulders, and weighing several tons, was swept from its pedestal and carried southward about 45 feet. All the evidence collected in this connection cannot here be presented, but it indicates that the blast which wrought the havoc referred to passed over the city with full hurricane force.

EXPLORATIONS IN ST VINCENT

Space will not permit me to detain the reader longer with this preliminary account of the travels of the commission of the National Geographic Society. On leaving St Pierre at the close of our second day's visit, we returned to Fort de France, and the following day the *Dixie* sailed for St Vincent. Professor Hill remained at Martinique, while Commander Borchgrevink and I went southward to study the eruption of La Soufrière.

On St. Vincent the loss of life from the second volcanic explosions was far less than on Martinique. As has been reported by the Governor of the island, the number killed was about 1,600. Many more were injured, however, than during the eruptions of Mont Pelée. The region about La Soufrière was less densely populated than the northern shores of Martinique; there was no city comparable to St Pierre in proximity to the

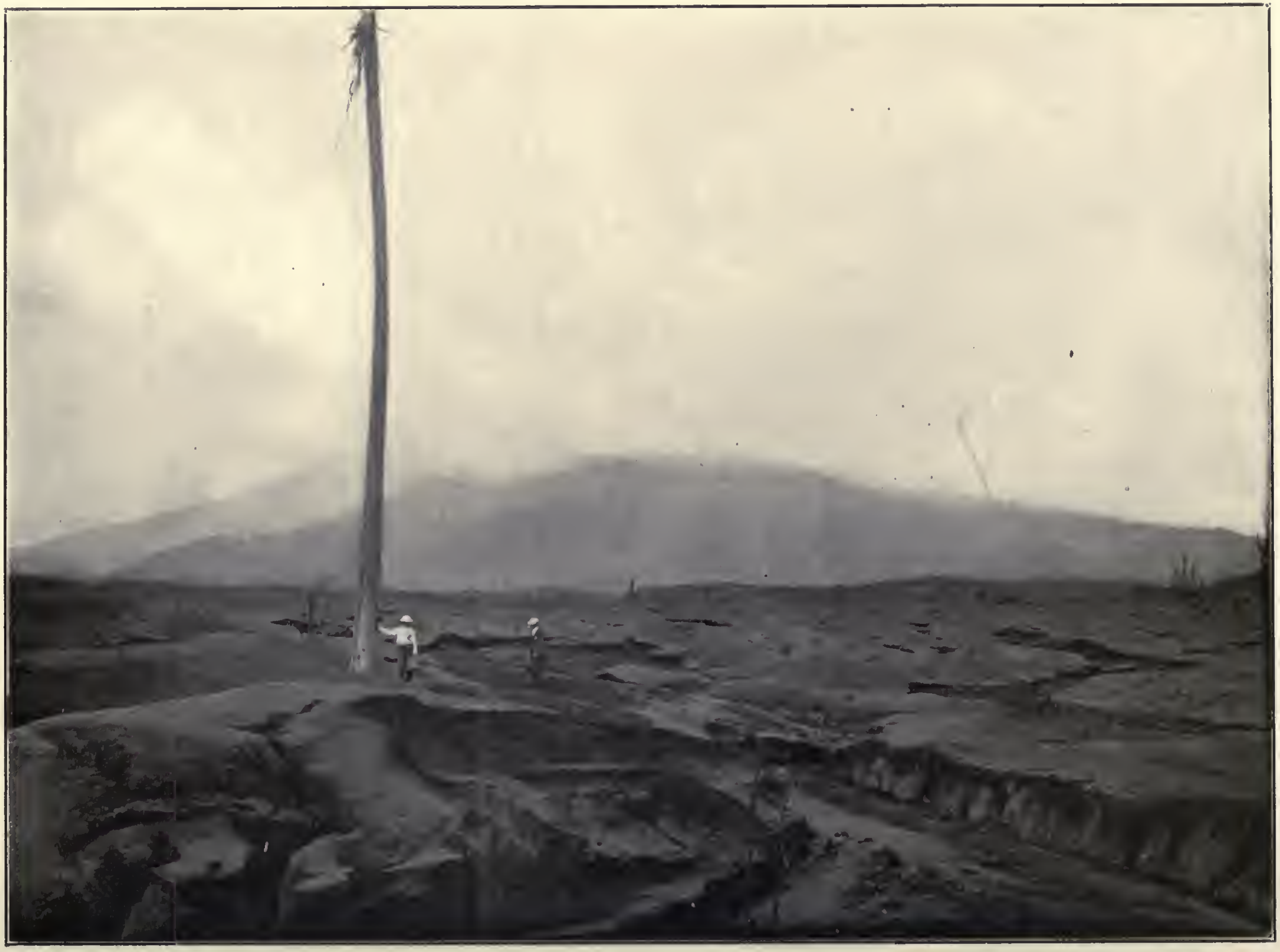


Photo by Israel C. Russell

" On the slopes about us still stood the denuded trunks of palms " (*see page 275*) volcano; but what is significant is that the people of St Vincent heeded the warnings given by their troubled mountain and many lives were saved which otherwise no doubt would have been lost.

The destruction on St Vincent was due to dust, lapilli, and stones, which fell on the land while yet hot; but a hurricane blast of steam charged with burning dust did not sweep down from La Soufrière as it did from Mont Pelée. The area on which the dust and stones fell while yet sufficiently hot to destroy the vegetation was about twice as great as on Martinique, and extends in a belt some six miles wide across the northern end of the island, leaving, however, a narrow strip of verdure on the extreme northeast coast, as is shown on an accompanying map.

The *Dixie* reached Georgetown, the capital of St Vincent, on the morning of May 23, and later the same day, through the courtesy of Mr F.W. Griffith, who had immediate charge of the distribution of the relief stores for the colonial government, I was enabled to make a trip on the steamer *Wear* northward along the west shore of the island to the devastated region about La Soufrière. A similar and more successful trip on the same boat was made the following day, during which a landing was effected at the mouth of Wallibu River and the country about Richmond House carefully examined.

While proceeding northward on the *Wear*, calls were made at the villages on the shore, where people driven from the devastated district had taken refuge, and an opportunity was afforded of seeing the stores brought from the United States actually placed in the hands of those to whom they had been sent. A similar gratifying sight was again seen a few days later at Georgetown, on the east coast of St Vincent.

On landing at the mouth of Wallibu River we saw before us a scene fully as desolate as at St Pierre. Near the shore, where a village of some 400 or 500 people stood on the morning of the 7th of May, we walked over the barren, wind-rippled, and rill-cut surface of a fresh deposit of volcanic dust and stones some 50 or 60 feet deep. This village, as in the case of the northern portion of St Pierre, was situated at the margin of a broad sloping upland, from which the débris was swept and piled deeply on the flat land to leeward. After inspecting Richmond House, a strongly built structure of stone, the partial ruin of which resulting from a hurricane a few years since had been completed by the recent eruption, I pressed on, in company with Dr Hovey and Mr T. M. McDonald — the latter the owner of neighboring estates and one of them now buried beneath the desolate covering of stones—to the bluff overlooking Wallibu River, and had an unobstructed view of the deeply filled valley of that stream and of the slopes of La Soufrière, even to its still steaming summit. Never have I gazed on a stranger or more instructive scene. We had caught Nature at work at one of her most marvelous tasks. On the slopes about us still stood the denuded trunks of palms, their sides facing the volcano stripped of their bark and scorched, showing that the wind during the storm of hot dust and stones had blown from the direction of the volcano, but not with the extreme violence so manifest at St Pierre. The hills about us were covered to the depth of three to four feet with dust and stones, then cold, and compacted so that we could walk over the surface of the layer without difficulty. One of the many interesting features to claim attention was the wonderful manner in which the layer of fresh débris had been cut by the rills originating on it from the recent heavy rains. A most beautiful system of dendritic drainage was there in active development. The rills and brooks had in many instances cut channels through the fresh layer and exposed the cultivated soil beneath. The steep-sided trenches, with well-marked terraces, to which many tributary rill channels converged, were, in miniature, canyons like those of the Colorado region. Some of these instructive details may be recognized in the accompanying photographs.

Among the larger features of the recent changes that especially attracted attention was the manner in which the steep-sided valley of Wallibu River, perhaps a quarter of a mile broad, had been deeply filled with fresh, hot débris, and the way the displaced stream was endeavoring to regain its right of way. The valley had been filled, as estimated by Mr McDonald, to a depth of 50 or 60 feet with freshly fallen débris. Through this material, surface water was working its way, and, meeting the still hot stones and dirt, was being changed to steam, which, escaping from thousands of vents, formed white columns that rose at times hundreds of feet into the air. This wonderful display of steam jets and geyser-like eruptions, varied in grandeur with the amount of surface water present. During the intervals between the occasional heavy downpour of rain, the energy of the escaping steam would decrease, and a person could walk in safety over a miniature crater, from which steam had previously been seen to rush out as from the escape valve of a steamship, but with ten or a hundred times its volume. During a heavy shower, however, as happened at the close of my second excursion to the Wallibu region, the volume of steam became so great that the entire landscape was obscured, and the upward rolling clouds ascended for thousands of feet. On such occasions the roar of the escaping steam could be heard a mile or more. The steam jets, at times, had such energy that black columns, consisting of what may be termed mud, were shot upward like geysers, to a height of fully a hundred feet, and would play for several minutes. These miniature eruptions have been referred to, in several newspaper accounts of the strange scenes on St Vincent, as volcanic eruptions from newly formed craters; but this is a mistake, as they were clearly due to the surface waters working their way through thick beds of hot dust and stones. A similar phenomenon was witnessed by me near St Pierre, and was seen again near Georgetown, and in each instance the cause was the same.

Wallibu River, as I have stated, was displaced from its former bed by the vast quantity of débris precipitated into its channel or washed from the bordering uplands. At the time of my visit the stream was behaving in a most peculiar and interesting manner. Not only was it a stream of hot water from which steam was being given off in large volume, but, owing to the vast quantity of loose material present, was overloaded. The débris checked its flow, and for a time would hold back the water and act as a dam, the stream bed downstream becoming dry, and as the pressure of water increased, the dam would give way, and a large body of steaming water, black with material in suspension, would rush down the previously dry channel, and with a roar plunge into the sea. The stream made these pulsations at intervals, on an average, of perhaps twenty seconds, and between each swift rush of black, seething water its channel was vacant. A similar behavior of the stream near St Pierre, and also of those on St Vincent which reach the sea near Georgetown, was observed. Such examples of what may justly be termed overloaded and pulsating streams are certainly novel to students of the life histories of rivers.

From the heights above Richmond House the entire western slope of La Soufrière was in full view during our visit, and, like the corresponding side of Mont Pelée, was without life. Not

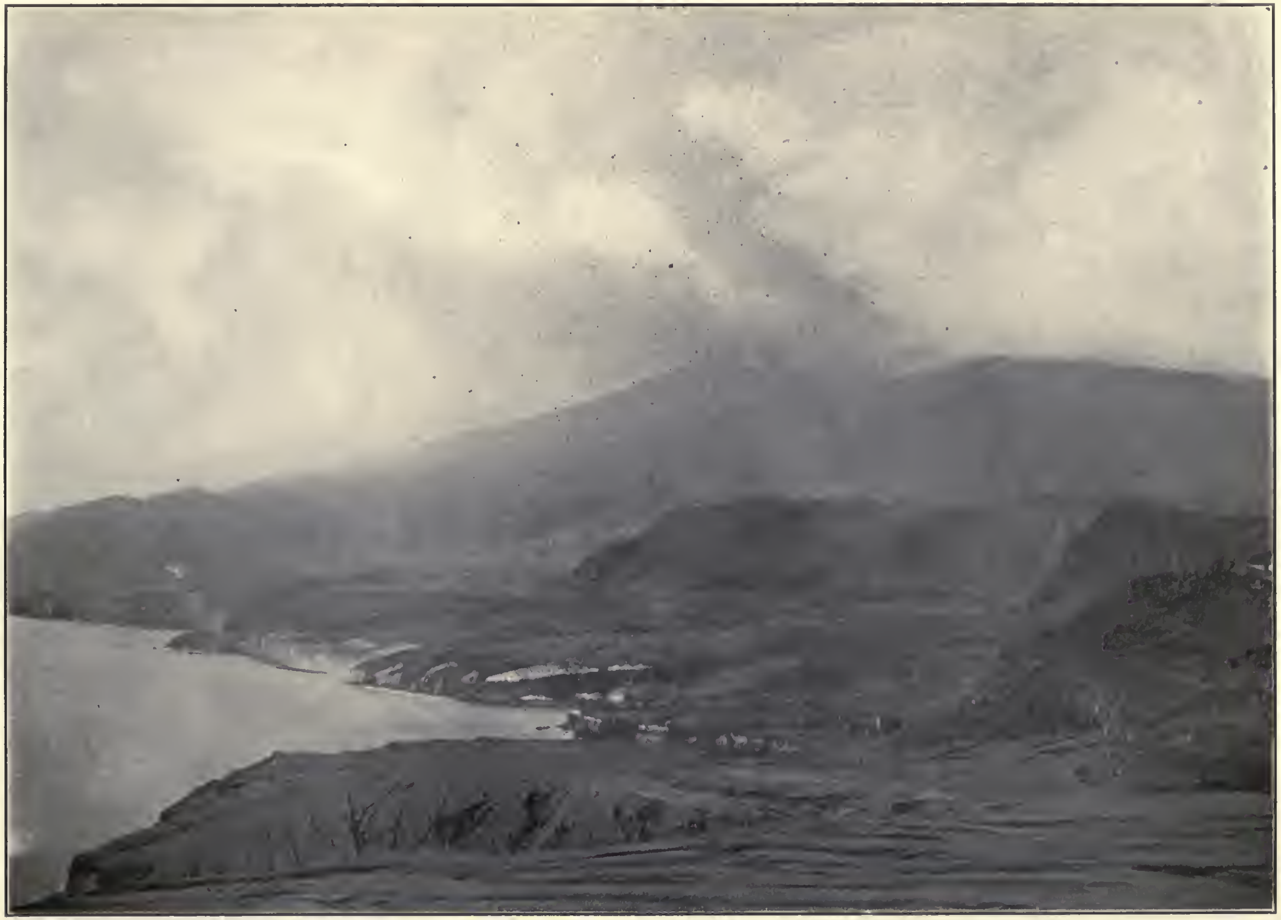


Photo by Israel C. Russell

The Devastated Slopes of La Soufrière

"Not a spray or leaf remained in all the stern oppressive landscape to suggest the loveliness that had so suddenly been blotted out" (*see page 278*) a green sprig was visible, but utter desolation reigned. Over all the devastated region lay a thick sheet of grey débris, forming a fresh page, on which the rains had everywhere begun to write their records in the form of rill-cut channels. The newly added material, which so recently formed a part of an ascending column of lava in the throat of La Soufrière, was being rapidly removed and taking its place in the sedimentary deposits of the sea. Every downpour of rain witnessed the washing from the land of tens of thousands of tons of this fresh covering. The removal of the newly fallen material is going on with such rapidity that within a few months, or at most a year or two, it will have been completely denuded from the hills and mountain side, but will long remain in the valley. Outside the devastated area, where the fall of dust and lapilli was cold and in depth did not exceed an inch or two, it had been already, at the time of my visit, washed by rain so that the vegetation was again green, and its presence on the ground beneath inconspicuous.

Our return from the interesting excursion referred to above was precipitous, not because La Soufrière showed signs of renewed activity, as did Mont Pelée on a similar occasion a few days before, but owing to the coming of one of those sudden showers so characteristic of tropical regions. A rain squall swept over us. The wind caused the waves to rise and break in surf on the beach. Through the surf we went to reach our boats, and after some difficulty regained the *Wear*, drenched to the skin. The clothing brought by the *Dixie* was, as we understood, for the benefit of all those made destitute on account of the recent volcanic eruptions, and soon my companions and myself were arrayed in the uniform of the U. S. Army, while our citizen's clothes were drying.

On leaving the site of Richmond village the *Wear* continued northward, passing as near the shore as prudence would permit, and gave her passengers a splendid view of the blasted and utterly desolate mountains. The northern part of St Vincent is remarkably rough and possesses some unusually fine scenery. We could see far up the steep trench-like valley leading to the summit of La Soufrière, where palms formerly lifted their plumes far above the luxuriant flora of the forest, and birds haunted the shadowy recesses where orchids bloomed, but all was dark and silent. Not a spray or a leaf remained in all the stern, oppressive landscape to suggest the loveliness that had so suddenly been blotted out. At the north end of the island we passed the Fancy estate, where some 50 persons were killed on May 7, and obtained a view of the still green strip of land and projecting cape on the extreme northeast portion of the island, which, strangely as it seems, escaped destruction.

On returning to Kingstown we found the work of discharging the relief stores brought by the *Dixie* still in progress, and through the untiring courtesy of Mr Griffith I was enabled to make another trip on the *Wear* in company with Drs Jaggar and Hovey and others, this time to Georgetown, on the east side of St Vincent.

On passing around the southern end of St Vincent and steaming northward we found the usual heavy swells rolling in from the broad Atlantic, and as our course lay parallel with the waves the *Wear* rolled heavily, much to the discomfort of many of her passengers. Arriving off Georgetown, the anchor was dropped, and a landing effected by means of a strong boat which put out from the shore. The landing was novel, and to a novice somewhat exciting. Some distance out from the end of a long pier was a buoy, with a cable passing in to the shore and alongside the dock. The shore boat, manned by

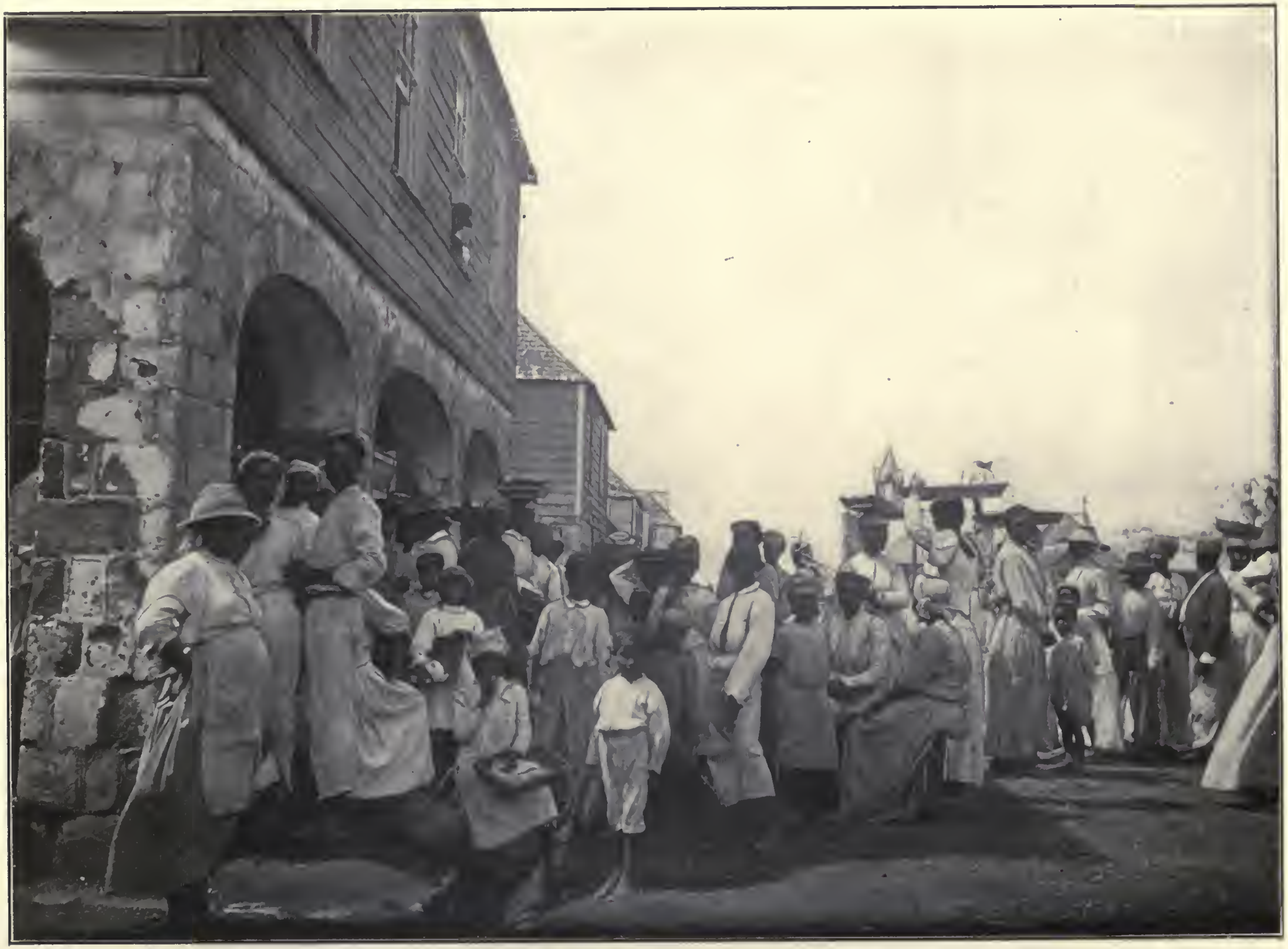


Photo by Israel C. Russell

Natives of Kingstown, St Vincent

Photo by Israel C. Russell

A Typical Town of the West Indies

strong Africans who well understood the situation, was loaded with relief supplies for the hundreds of refugees in Georgetown, on the top of which as many men as wished took passage. The boat was rowed to the buoy, where, after many unsuccessful attempts, the cable leading shoreward was grasped by strong hands. The waves were there rolling heavily, surging through the timbers of the pier, and breaking with a heavy roar on the gravelly beach. By means of the cable the boat, with her freight of American codfish, American bacon, and living examples of the people from the same land, was drawn alongside the pier and held there, although surging up and down with each incoming wave. From the pier projected a rude derrick, made of boards, at the end of which was a pulley, and over the pulley passed a rope from which was suspended a rectangular box about three feet square. The derrick and cage had been made hurriedly, for the purpose of embarking some of the people injured during the late disaster, and was by no means an attractive vehicle in which to be lifted from a crazy boat. The ascent was made safely, however, but the uncertainties attending it awakened the keenest sympathy for the sufferers who descended by the same means an hour later.

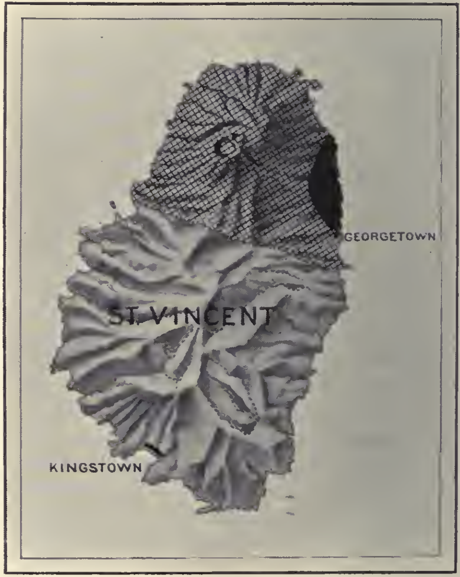
From the extemporized hospital some forty of the convalescent patients, who were burned on May 7, were taken to the end of the pier, lowered into the dancing boat, and conveyed to the *Wear*, where they were taken on board by strong, willing hands as gently as the circumstances would permit and placed on mattresses on the deck. All of the wounded were suffering from burns on the hands, feet, face, and neck, inflicted by hot dust. Of the injured on St Vincent, numbering, I believe, about three hundred, all suffered from burns of the nature just referred to, excepting a few who were struck by falling stones.

THE DISASTER AT GEORGETOWN

At Georgetown the fact that a terrible disaster had recently occurred was impressed on my mind even more forcibly than during my visit to St Pierre. The beautiful city on Martinique was so completely devastated that comparatively little remained to proclaim the tale. But for the presence of the bodies of the dead, the ruins might, seemingly, be a century old. At Georgetown, however, although the town was but partially ruined, and no loss of life occurred within its immediate borders, the dust and stones piled high in the streets, the shattered windows and roofs, the blasted palms to which the yellow leaves still adhered, the absolutely barren field adjacent, and the still steaming rivers of mud, flowing from the shrouded slopes of La Soufrière, all appealed most forcibly to the imagination, and assisted in enabling one to picture in fancy what had occurred. The people who had been exposed to the great peril still thronged the streets. In the outskirts of the town, refugees were crowded in houses inadequate for their shelter. About the door of the storehouses groups of eager applicants were receiving government aid, but no acute suffering was visible, except in the church which had been converted into a hospital. Most pathetic was the sight of the scores of injured persons, all of them, I believe, negroes, although their wounds had been well cared for by the physicians early on the scene.

Leaving the half-ruined town, with its few remaining trees, which formed a narrow strip of verdure between the sea and the desolated arrowroot field leading up to the base of the volcano, I hurried inland, in company with Dr Hovey and two negro lads, who carried our cameras, to visit Dry River and get a view of a typical example of the region on which the descent of dust and stones had been heavy. This same region was buried beneath volcanic débris in 1812, during the preceding eruption of La Soufrière, and, as I have been informed, the material which fell at that time is of the same general character as that recently showered on the island. Dry River, as I understand, derives its name from the fact that its channel was in part abandoned, owing to the quantity of débris accumulated in it during the eruption referred to. To that filling another contribution has just been made. Like Wallibu River, described above, the streams near Georgetown were working their way through deep deposits of hot débris and sending up vast volumes of steam. Our tramp took us across previously cultivated fields, now buried some two feet deep beneath stones and dust, and across small streams of warm water, which were vainly endeavoring to rid their channels of the recently added material. The view toward the volcano and northward along the coast, where several fine plantations or estates had been ruined, although depressing in the extreme on account of the devastation that had been wrought, was highly instructive as an example of volcanic action. It was in this region that the greatest loss of life on St Vincent occurred during the recent disaster. In one house which we visited 21 persons perished—all who sought its shelter. The wood-work of the house was not burned, and no other evidence remained of the death-dealing agency except the layer of dust on the floor, which was extremely fine and had a depth of about four inches. The windows of the house, which faced eastward, were badly shattered, the glass being broken by stones which passed through them from the outside, and their frames were indented in such a manner as to show that the falling stones struck with considerable force. This interesting observation, taken in connection with other facts, shows that the stones shot upward by La Soufrière rose through the layer of the atmosphere affected by the westward blowing trade winds, and on reaching the higher region of the atmosphere, where the wind is known to be blowing from west to east, were carried well to the eastward of Georgetown, but on falling were again swept westward by the trade wind, accented, it is to be presumed, by an indraft toward the erupting volcano, and given such a slant that on striking the windows referred to they passed through and entered the rooms within.

On St Vincent the rain of dust and stones was similar to that which fell on Martinique, but in general the material is coarse. Throughout the desolated area rough, angular stones, some 5 or 6 inches in diameter, fell in vast quantities, and at a distance exceeding about five miles from the volcano dust and lapilli descended so abundantly that even at Kingstown, 12 miles from La Soufrière, the fresh layer formed was about three-fourths of an inch thick. At Chateau Bellair, on the west coast, and again at Georgetown, on the east coast, each distant about five miles from the volcano, I found the level fields coated with a new layer of volcanic débris about 2 feet thick. This is a minimum measure of the depth of the disastrous shower of stones on the devastated area, and the average thickness of the deposit is several times as great. This material, it must be remembered, came down while yet hot and many of the stones were still glowing when they struck. Not only were the stones that fell on St Vincent larger than those which descended on Martinique, but, what is also instructive, stones of two classes are conspicuous on the desolated fields. The greater part of the débris consists of gray scoriaceous andesite, and came from the columns of fresh lava that rose in the conduit of La Soufrière. This material was sufficiently cooled to become solid before it was blown into the air, and to a great extent was reduced to dust by the sudden expansion of the steam it contained. In addition to the fragments of fresh lava, the fields are strewn with angular masses of older and much more compact rock, which was torn from the walls of the conduit of the volcano by the uprush of molten material and steam and blown high into the air. These fragments of old rock



Sketch Map Prepared by Israel C. Russell Showing Zones of Devastation in St Vincent

The black area is the region of greatest loss of life ; the black and dark areas are the zone of total destruction. In the light area the vegetation was not injured except by light shower of volcanic dust.

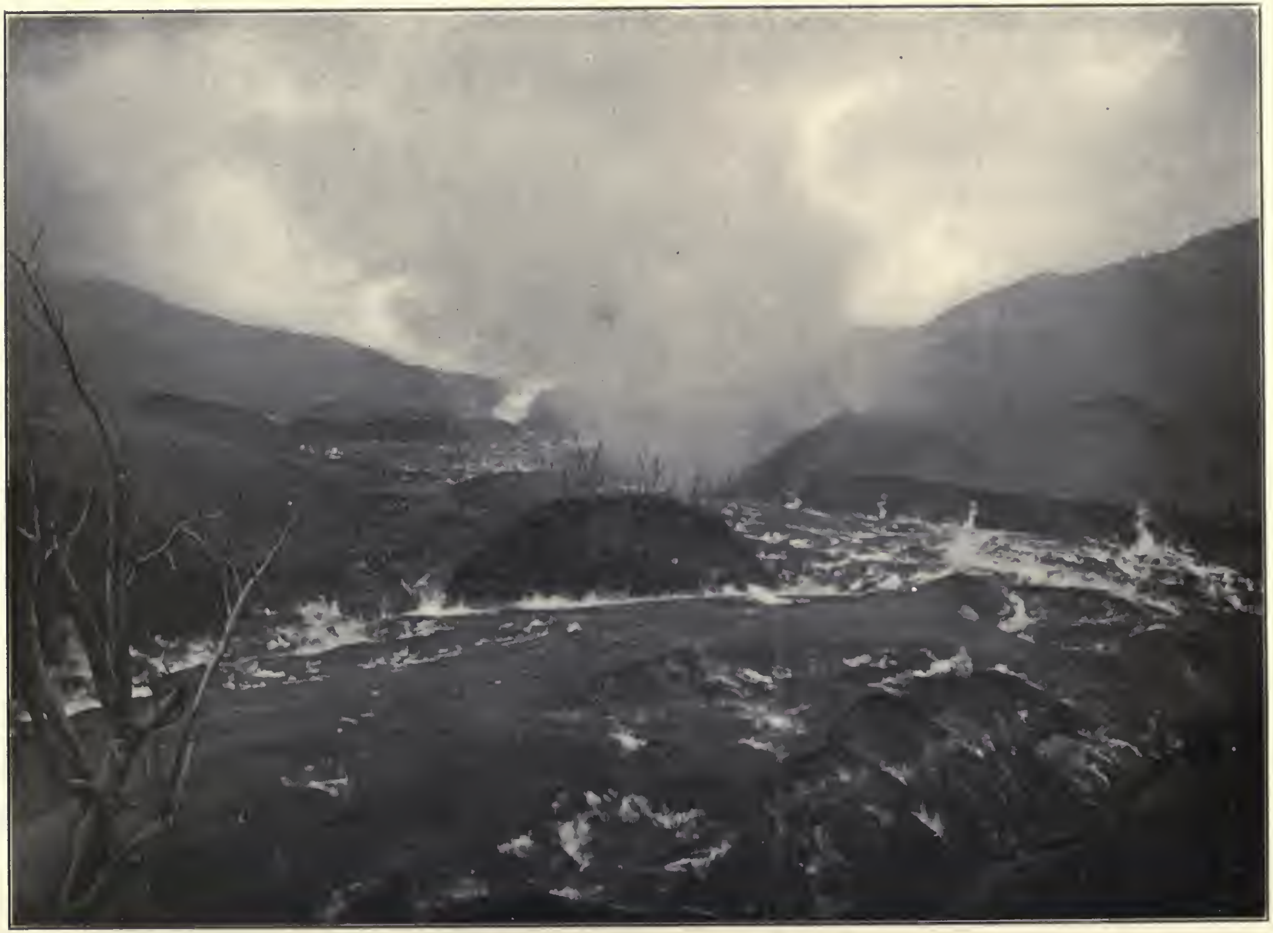


Photo by Israel C. Russell

A River of Mud Pouring from La Soufrière

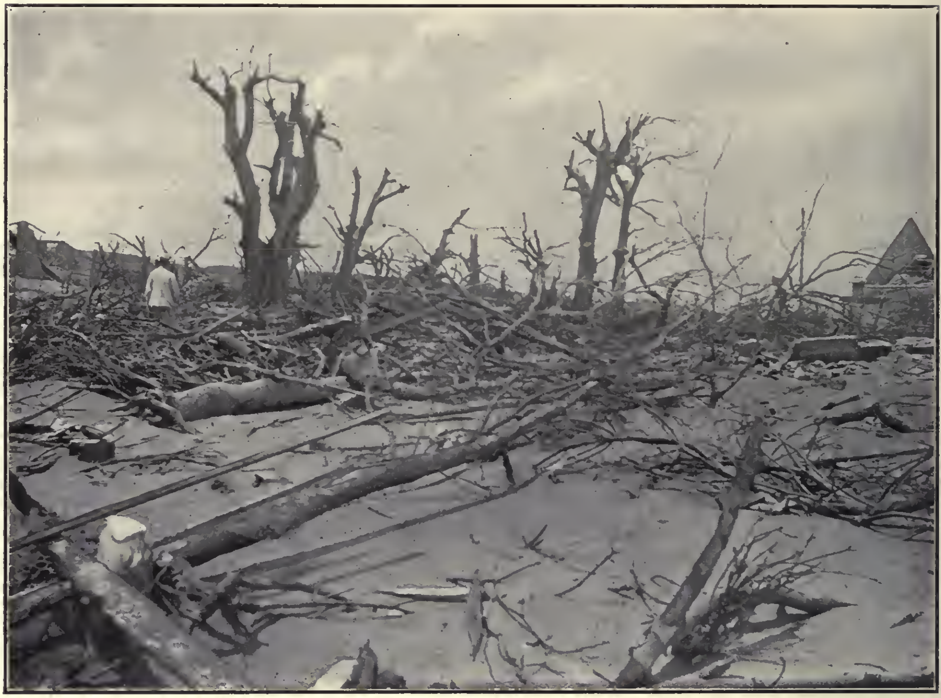


Photo by Israel C. Russell

Ruined Estates near Georgetown, St Vincent (*see page 282*)

are much more dense than the accompanying fragments of fresh lava and retained their heat longer. Those that fell on the desolated area were still red hot when they struck the ground and capable of causing the ignition of houses, etc. Where the hot stones accumulated about tree-trunks the wood in many instances was completely changed to charcoal. This material at the time of my visit to Georgetown was being gathered by the inhabitants in considerable quantities and used for fuel.

This brief account of the material which fell on St Vincent will, I think, show the main cause of the loss of life and the destruction of houses, vegetation, etc., on that island. The majority of the people killed, as on Martinique, in the opinion of physicians and others early on the scene, lost their lives from the inhalation of hot dust and being scalded by steam charged with burning dust. On the outer margin of the region of destruction the steam cloud seems to have condensed to scalding water, which was thick with dust and formed a hot mud that adhered to everything it touched. Casualties also resulted from the rain of falling stones, and, as has been frequently stated, lightning from the volcanic cloud was intense and frequent and is supposed to have caused many deaths.

After returning on the *Wear* to Kingstown, where the *Dixie* still lay at anchor, visits were made to interesting places on shore, including the beautiful and well-kept botanical gardens in care of Mr Henry Powel. Early on the morning of May 29 the *Dixie* started for Port Castries, St Lucia, arriving there about noon the same day, and the following day returned to Fort de France. On May 31 the good ship sailed for home, bearing, of your commission, Professor Hill and myself, Commander Borchgrevink having previously started northward on a passenger steamer.

The morning we bade good-bye to Consul Ayme, at Fort de France, dawned unusually fair. There was not a cloud in the sky except the vast columns of steam rising from the still active crater of Mont Pelée, which rose, as determined by angulation by Lieutenant Bernadou, to a height of 15,000 feet. On passing the site of St Pierre we had a last but distant view of the dead city. At the end of a pleasant homeward voyage the *Dixie* once more dropped her anchor in the harbor of New York on June 6.

This hasty letter I trust will serve to show the members of the National Geographic Society, at least in a general way, the nature of the observations their agents were able to make; but I trust it will in time be followed by a critical discussion of the very characteristic explosive volcanic eruptions which desolated such large portions of the otherwise charming islands we visited.

UNIVERSITY OF MICHIGAN,
June 20, 1902.

VOLCANIC ROCKS OF MARTINIQUE AND ST VINCENT

COLLECTED BY ROBERT T. HILL AND ISRAEL C. RUSSELL

DESCRIBED BY J. S. DILLER

SOON after the disaster of St Pierre the U. S. Weather Bureau sent to the Geological Survey for examination a bit of volcanic dust collected May 8, 1902, aboard the steamship *Coya*, 185 miles southeast of Barbados. To this was added later some of the volcanic sand which fell on Barbados, and the source of the material, whether from la Soufrière, on St Vincent, or Mont Pelée, on Martinique, both of which were in eruption about the same time, was a matter of much interest. Therefore when I received from Professor Hill for study the material which he collected at Martinique during his investigations for the National Geographic Society, I anticipated much pleasure in searching for the source of the dust.

Professor Hill's collection embraces 33 specimens; 30 came from Martinique and 3 from St Vincent. Of the Martinique specimens, 18 resulted from eruptions long antedating the present volcanic activity, 6 are ejecta of recent date, and 6 are "fumarole deposits" on the slopes of Mont Pelée.

The rocks of Martinique are remarkably simple, and belong to well-marked types of andesite, with normal variations representing traces of earlier conditions deep within the earth. The great volcanic belt along the axis of the two continents from Cape Horn through the Americas to Point Barrow is composed largely of this kind of volcanic rock, which indeed gets its name from the Andes Mountains, where it was early discovered.

In the prevailing rock of the collection hypersthene is the characterizing ferromagnesian silicate, and it is commonly associated with some augite. In closely allied specimens hornblende comes in and increases until in a few of the specimens it characterizes the rock as hornblende andesite. The hornblende is always of the deep brown, strongly pleochroic variety, with rounded black border, which indicates that the hornblende during the later portion of the molten stage of the lava was undergoing resorption. Next to magnetite hornblende is among the earliest products of crystallization in the magma, as it rises by eruptions from deep in the earth toward the earth's surface. Arriving near or at the surface, where the conditions of pressure and temperature have greatly changed, hornblende is no longer stable, and is gradually attacked and resorbed by the magma, to crystallize out upon final solidification as pyroxene either as augite or hypersthene. While it may not be asserted that all the hypersthene andesites of the collection once contained hornblende, it is certain that some of them did, and that if the molten condition had continued long enough after reaching the surface all the hornblende would have disappeared.

Arranging the andesites according to their characterizing ferromagnesian silicates, there are about a dozen hypersthene andesites, several of which contain augite and a few hornblende. There are two hornblende andesites carrying more or less hypersthene. The hornblende andesite is associated with hypersthene andesites, with and without hornblende among the lavas of earlier eruption. The product of the late dsetructive outburst is hypersthene andesite.

EARLIER VOLCANIC ROCKS

To illustrate the products of earlier volcanic activity on Martinique previous to the eruption of May 8, 1902, examples were collected of building stones in St Pierre (Nos. 6, 7, 8, 11, and 13), building stones in and near Fort de France (Nos. 9, 12, and 15), and from Font St Denis (Nos. 10 and 14). The other specimens embrace boulders from Precheur (No. 1), fragments from Fumarole Island, mouth of Rivière Blanche (No. 2); Carbet Peak (Nos. 3*a* and 3*b*), Pitons, Mount Carbet (Nos. 4 and 20), and St Pierre (No. 5), and black sand of Beach Precheur (No. 31).

Hypersthene Andesite. — Specimens (No. 1) bearing the label "Precheur boulders, old rock," are good examples of hypersthene andesite. To the naked eye the rock looks uniformly gray, and only on a second closer look one perceives that it is peppered full of small crystals. Many are black, but most are white.

Under the microscope in thin section these crystals stand out more conspicuously in a gray groundmass, and the structure is microporphyritic. The white crystals are plagioclase, the dark ones are mostly hypersthene, with some augite and numerous grains of magnetite. The plagioclase in transmitted light generally becomes clear and colorless, and between curved nicols shows lamellar twinning. Some are full of inclusions arranged more or less clearly in concentric shells of crystal growth. The angles of extinction of the plagioclase suggest that it is a lime-soda feldspar approximating the composition of labradorite.

The hypersthene occurs in small 8-sided prisms, in which the four predominating planes are pinacoids. It is strongly pleochroic yellowish to greenish, and has parallel extinction, distinguishing it from the greenish augite, which is not pleochroic and has a large angle of extinction.

The groundmass in which all these crystals are imbedded is dark gray, and contains a multitude of embryonic crystals, chiefly, if not wholly, of the minerals already mentioned, swimming in a clear glassy base.

From "beach at Precheur" is an interesting specimen (No. 31) of "black sand," marked "not of present eruption." The sand has evidently been washed by wave action, and nearly all the lighter particles, feldspar and glassy groundmass, removed, leaving the magnetite and hypersthene. A magnet separates the brilliant black magnetic grains from the more or less perfect crystals and cleavage plates of hypersthene. Most of the plates are of prismatic cleavage, but some are macropinacoidal and show a bisectrix. Neither hornblende nor augite were observed in the sand. Its composition is remarkably simple as compared with the auriferous black sand of Oregon and California.

In addition to the above, fragments of old hypersthene andesite were obtained at nine other localities. They will be briefly noted, calling attention only to points of difference as compared with that already described.

Among the "building stones of St Pierre, old rocks of the adjacent country" (6, 7, 8, and 11), there is but little variation, and that chiefly in the fineness of the groundmass. One specimen (8) differs from the others in containing some augite and having a larger than normal proportion of phenocrysts, prominent crystals. Another (No. 13) contains a trace of deep-brown hornblende. The two samples (Nos. 9 and 12) of hypersthene andesite from near the barracks, five miles north of Fort de France, marked "old rock south of Pitons du Carbet," are of the normal type.

In three of the specimens of hypersthene andesite considerable alteration had taken place. No. 10, from "Font St Denis, old rock between Pitons du Carbet and Pelée," has no hypersthene. Its place is occupied by a deep-green, more or less fibrous, platy, pleochroic mineral, with stronger birefringence than ordinary chlorite. In No. 14, from "Font St Denis, old rock covered with new ash," the pyroxene is partly replaced by the chloritic mineral noted above and surrounding calcite.

A pebble (No. 3*a*) "from a ravine on upper slope of plateau" is hypersthene, with a trace of augite and more crystalline groundmass. The hypersthene of the groundmass and some of the larger particles have altered to a yellowish-green product, in the coloring of which oxide of iron may have played a part.

Hornblende-hypersthene Andesites.—These differ from the normal hypersthene andesites in containing a small amount of brown hornblende, which has a narrow but dense black border. There are no groups of pyroxene and magnetite to represent grains of hornblende wholly resorbed, nor from the character of the border here could such be expected.

One specimen of this type (No. 15) occurs "near the barracks, five miles north of Fort de France," and the hornblende crystals in the hand specimen appear prominent enough to place it among the hornblende andesites, but in the section under the microscope it most closely resembles hypersthene andesite. Another (No. 5) is from St Pierre. It varies from the normal hypersthene andesite not only in containing a trace of hornblende, but also a grain of olivine, the only one found in Mr Hill's collection from Martinique. A good specimen (No. 2) is "old rock from Fumarole Island, mouth of Rivière Blanches," with dark felty groundmass, like many of the typical hypersthene andesites.

Hornblende Andesite.—The hornblende andesite is of a light gray color and decidedly porphyritic even to the unaided eye, with conspicuous black crystals chiefly of hornblende, attaining in a few cases a length of five millimeters. The white or glassy crystals of feldspar are less prominent, and all are imbedded in a light-gray groundmass. Under the microscope hypersthene and magnetite and also the plagioclase are seen to occur as in the hypersthene andesites, but less abundantly, and the feldspar may be somewhat less calcic. The groundmass is lighter colored, filled with minute clear crystals and grains like feldspar, with few that are colored in a glassy base.

The only specimen of this type in the collection is No. 3*b*, "Carbet Peak, from a ravine on upper slope of plateau," although No. 15, from near the barracks, five miles north of Fort de France, should be mentioned here as closely related.

Dacite (*Quartz Andesite*).—One of the most interesting specimens is the dacite No. 4, "Pitons, Mount Carbet, material of peak." It is a light gray, conspicuously porphyritic rock. The light-colored phenocrysts are quartz and feldspar, the dark ones, chiefly hornblende, attaining in some cases a diameter of 8 millimeters. One apparently hexagonal scale suggests biotite. The quartz is much fractured and did not appear in the thin section, but the conchoidal fracture and uniaxial positive character of one of the glassy grains leaves no doubt as to its presence and places the rock among the quartz andesites.

The feldspars are more prominent, and the crystals broader proportionally than in the hypersthene andesites. Twinning bands are broader and sections more common in which these appear, and it is possible that some orthoclase may be present with the plagioclase. Augite and black-bordered deep brown hornblende are among the phenocrysts. The light gray groundmass is filled with small crystals of feldspar and hypersthene, with some grains of magnetite in a clear glassy base.

The dacite is much more closely related to the andesites than the dacites associated with similar andesites about Crater Lake, Oregon.

From the same locality ("Pitons Carbet, decomposed old material") comes specimen 20, which is much altered. It is friable, earthy white, spotted reddish brown with oxide of iron. Looked at more carefully, grains of quartz occur and connect it with the dacites.

Under the microscope the feldspars are found to be entirely replaced by a clear isotropic substance, and the ferromagnesian silicates are represented by oxide of iron. The groundmass has been converted into an aggregate of minute grains of a light-colored mineral like quartz or feldspar, and stained more or less deeply by oxide of iron. Several of the original quartz-phenocrysts occur in the thin section unaltered.

PRODUCTS OF THE RECENT ERUPTIONS FROM MONT PELÉE

Hypersthene-andesite Pumice. — We now come to the material which Mr Hill regards as immediately connected with the great eruption of May 8, 1902, in destroying St Pierre. It is the consolidated molten material of that outbreak. Only two pumiceous fragments (Nos. 16*a* and 16*b*) were selected from a large number for examination. They were collected "near Rivière Mare." One of them (16*a*) readily sinks in water, but the other, rounded as if water-worn, floats lightly. They differ only in degree of porosity, due to the difference in number and size of the vesicles.

The pumice is nearly white, sprinkled with small black spots, which under the microscope are found to be crystals and fragments of crystals of hypersthene and grains of magnetite. With them are clear crystals of plagioclase feldspar, probably labradorite or bytownite, and all are included in a very vesicular, dusty-looking, glassy groundmass. The vesicles range in size from less than .01 of a millimeter to several millimeters in diameter, and in shape from spherical to linear. They may be best seen with a small lens in the hand specimen, where the fibrous drawn-out character due to the expansion of the gas in the vesicles is evident. Flow lines occur in the glass about the elongated vesicles, and its whole aspect indicates clearly that the material now glassy was once soft and fluent like paste, and while in that molten condition contained gases or vapors which expanded and formed vesicles, whose elongation took place in the direction of motion within the mass.

Here we have the seat of expansive and explosive energy, which must have played a most important part in the eruption, and we may briefly consider it, but only from a petrographic standpoint. Many of the vesicles completely closed must still contain in some form more or less of the gaseous agent that produced the vesicle, but these are almost wholly lost in the preparation of thin sections for microscopic study, and their ultimate determination must be relegated to the chemist. There can be no doubt, however, that a large part of the gaseous matter given off is steam. The source of this water and other gases contained in the molten material, magma, as it rises to the earth's surface in eruption we will not discuss, but what happens to it in the process of crystallization concerns the specimens we are considering.

Crystallization is a process of exclusion; so it happened that as the magma of Mont Pelée approached eruption crystals of magnetite and hypersthene developed with a still larger number of plagioclase, and the absorbed gases rejected in this process became concentrated in the unconsolidated portion. When the pressure was relieved the liberated gases expanded, producing the vesicles and giving rise to pumice of different degrees of porosity. Specimen 16*a*, although very vesicular, is much less so than 16*b*, for it quickly sinks in water, while 16*b* readily floats.

We can easily imagine the process of expansion to advance beyond the pumice stage even until the bubbles burst and the whole mass be blown to fragments, giving rise to lapilli and dust, of which the collection contains a number of examples. The gases filling the vesicles were the most mobile part of the mass, and like bubbles in water responding to the common impulse, moved in the same general direction, but slowly, and accumulated to form the big bubbles which produced the explosions. The eruptions of Mont Pelée, as in volcanoes generally, are a series of explosions due to the rupture of great bubbles formed from the accumulation of smaller ones like those of the pumice just described.

According to Professors Hill and Russell, there were no regular flows of molten lava from Mont Pelée during the recent eruptions. The magma was so full of absorbed gases that it was all blown out before effusion took place. The only flows were the so-called "mud flows," consisting of ejected material, lapilli, sand, and dust, so saturated with water as to flow in landslide fashion on slopes sufficiently steep.

The fragments of pumice described above probably represent more closely than any other material we have from Mont Pelée the general composition of the erupting magma. A chemical analysis by Mr W. F. Hillebrand is No. 1 in the table, page 291. Having considered the erupting magma, the ejected material will be taken up, beginning with that of May 8.

Sand and Dust from the Eruption of May 8.—The British ship *Roddam* was in the harbor of St Pierre at the time of the great explosion on Mont Pelée, about 7.45 a. m., May 8, and specimen 21 is dust which fell on the deck of the *Roddam* at that time.

The material was washed and separated by decantation to facilitate study. The largest particle of the specimen has a diameter of about 1.5 centimeters; but, judging from reports, much larger fragments must have fallen on deck at that time.

The material consists of small lapilli, sand, and dust ranging from the diameter stated down to particles invisible to the naked eye. Its color is dark gray. Plagioclase crystals and fragments are abundant; hypersthene and grains of magnetite somewhat less so; but at least half of the mass is dark microlitic, more or less felty, but not vesicular groundmass, often inclosing or clinging to crystals, and appears identical with the groundmass of the lavas of Mont Pelée antedating the last eruption.

There is a small amount of clear glass, which may represent the molten material in which the gas moved to accumulate for explosion, and this view is rendered more probable by the occurrence of particles of pumice similar to 16*a* and 16*b*; but it appears certain that the greater portion of the material which fell on the *Roddam* was derived from the pulverization of solid rock about the volcanic vent of Mont Pelée, and only a small part from the molten magma which was the seat of the explosion.

Sand and Dust from the Eruption of May 20.—The steamship *Potomac* was in the harbor of Fort de France, about 20 miles from the place of the explosion on the slopes of Mont Pelée, May 20. Specimens 23 and 24, which are identical, illustrate the character of the sand and dust that fell at Fort de France on that occasion. The color is pale buff gray, and the range in size of particles up to about one millimeter. Having traveled through the air much farther from its source than that collected on the *Roddam* May 8, it is much finer.

The particles are too fine for discrimination with the naked eye, but under the microscope are found to be crystals of plagioclase, hypersthene, and magnetite, mixed with a larger proportion of dark microlitic groundmass, just as in the sand from the *Roddam* of May 8, excepting that the proportion of groundmass to crystals seems larger at the greater distance, and this is to be expected, for the brittle and lighter groundmass pulverizes and floats in the air more easily than the mineral particles. Some particles of clear glass occur, but they afford not more than a trace of the magma represented by the pumice.

A comparison of the material ejected May 8 and May 20 discovers under the microscope no certain difference between the two magmas, but chemical analysis, which deals with a larger quantity than a thin section, is more likely to recognize small differences. For this reason analyses were made by Dr Hillebrand, and are given in the following table (2 and 3, p. 291).

Cinders from the Streets of St Pierre, Martinique.—One of the specimens, No. 22 in the collection, has the above label, and represents the character of the rock rain upon that ill-fated city. It contains products of both eruptions—May 8 and May 20—and is a mixture of all sizes of fragments from .001 millimeter up to two centimeters in diameter. The largest pieces, of which there are only a few in a quart of material, are composed of smaller fragments cemented by a dark substance which Dr Hillebrand has tested and found organic.

In composition this specimen is like 21 and 23, excepting that it is somewhat coarser, and contains organic matter added after the eruption. One small fragment of hornblende was fonnd and most likely came from one of the older lavas, for none was observed in the pumice.

In the rain of volcanic ejecta at St Pierre the fine and light were carried down with the larger fragments, but it is evident that much of the finer and lighter material would be shot upward by the explosions to great heights above the large, heavy fragments to be spread far and wide by upper currents. Beyond the Island of Martinique the volcanic sand and dust from Mont Pelée are not represented in Mr Hill's collection.

CHEMICAL ANALYSES

	1.	2.	3.	4.	5.	6.	7.	8.
SiO_2	61.07	60.01	63.23	55.64	52.81	57.62	....	58.41
Al_2O_3	17.55	17.54	16 73	18.21	18.79	19.76	None.	17.85
Fe_2O_3	2.13	2.88	2.58	3.63	3.28	3 43		2.67
FeO	4 13	4.30	3.12	4.83	4.58	3.90		3.29
MgO	2.26	2.76	1.84	3.48	5.19	1.82	....	3.61
CaO	6.28	6.80	6.01	8.14	9.58	6.25	.20	6.81
Na_2O	3.50	3.41	3.71	3.55	3.23	3.79	.08	3.77
K_2O	.98	.89	1.11	.58	.60	.71	....	1.23
H_2O —	.23	.10	.17	.20	.20	.41	....	.34
H_2O +	1.37	.30	.48	.54	.17	.59	....	.86
TiO_2	.47	.45	.40	.98	.95	.87	....	.69
ZrO_2	F't tr. ?	?	?	....	....	....	....	....
CO_2	None.	None.	None.	None.	....	None.	....	....
P_2O_5	.15	.15	.15	.11	.15	.17	....	.24
SO_3	None.	None.	None.	None.	.33	None.	.29	....
Cl	....	....	....	....	.14	....	Strong tr.	....
S *	.016	Tr.	Tr. ?	.04	....	.11	....	....
NiO	None.	None.	None.	None.	.07	....	....	....
Mno	.21	.23	.18	.19	.28	.08	....	....
BaO	.02	.03	.03	.03	....	....	....	....
SrO	None.	None	None.	....	....	....	....	....
Li_2O	F't tr.	F't tr.	?	....	....	....	....	....
	100 366	99.85	99 74	100.15	100.35	100.08		....

* Where sulphur is reported in the above analyses the values given for FeO and Fe_2O_3 are in error by indeterminable amounts, which vary with the proportion of sulphur.

Martinique

1. Pumice from Mont Pelée, eruption of May 8. No soluble chlorides or sulphates. Analyst, W. F. Hillebrand.
2. Sand, deck of *Roddam*, eruption of May 8. Analyst, W. F. Hillebrand.
3. Sand, deck of *Potomac*, eruption of May 20. Analyst, W. F. Hillebrand.

St Vincent

4. Pumice from La Soufrière, eruption of May 7. Analyst, George Steiger.
5. Sand, Barbados. Analyst, Dr. Pollard.
6 Dust, steamship *Coya*. Insoluble in H_2O. Analyst, George Steiger.
7. Dust, steamship *Coya*. Soluble in H_2O. Analyst, George Steiger.

Crater Lake, Oregon

8. Hypersthene augite andesite. Analyst, H. N. Stokes.

Specimens were obtained from Barbados and a vessel far to the southeastward, but the character of the material, as well as its movement, noted by observers, indicate that it came mainly, if not wholly, from St Vincent, and will be described later.

"*Fumarole Deposits*," *Mont Pelée.*—The collection includes six samples of material (Nos. 25 to 30, inclusive), marked "Fumarole deposits." They are all essentially the same and may be treated together. In color they range from dirty white to buff and reddish brown. Under the microscope it is seen to be made up very largely of clear transparent particles, with others of light cloud appearance. They are about equally numerous. The clear ones generally show the lamellar twinning of labradorite, and look like those of the volcanic dust. The clouded material when crushed is found to be an aggregate of glass particles. Traces of hypersthene and augite and magnetite occur, but generally they appear to have been removed by the action of acid gases in the fumarole. Soluble salts may be present, but could not be determined microscopically. Mr Steiger tested one of the specimens (No. 25), but was unable to prove the presence of native sulphur. The material throughout appears to be volcanic—sand and not decomposed rock nor to any great extent deposits from the escaping gases.

Fragments from the Late Eruption on St Vincent.—Mr Hill did not visit St Vincent, but submitted a collection of three small specimens, Nos. 17, 18, and 19, of very vesicular lava from St Vincent presented him by Lieutenant Penny, of the *Dixie*. The exact location and date of eruption are not given, but it is presumed that they are products of the last eruption.

Specimen 17 is light-gray pumice, peppered with dark grains, but readily floats on water. Under the microscope it is seen to be made up chiefly of glass, which is rendered yellowish by dust-like particles. The glass is very vesicular and incloses crystals and fragments of plagioclase, with less hypersthene and a small amount of augite. Black grains of magnetite are numerous. The feldspar generally shows multiple twinning bands, but a few squarish sections are free from them. Many have well-marked zones of growth and are full of inclusions of dark glass with bubbles.

The hypersthene is strongly pleochroic from reddish yellow parallel to the lateral axes to pale green parallel to the vertical axis, and with parallel extinction. Cross-sections are nearly square, with the corners cut off parallel to the prismatic cleavage. There is but a trace of macropinacoidal cleavage.

The pale-green augite is less common and generally thicker, short prismatic crystals, with large angle of extinction.

A group of hypersthene and magnetite has for its center a lighter-colored clear grain, whose high index of refraction and birefrangence indicates olivine.

No. 18 is like 17, even to containing olivine, and contains also a trace of hornblende. In No. 19 neither olivine nor hornblende were found, and this is regarded as more likely to be the normal rock of the eruption than the others. An analysis by Mr George Steiger is given (4) in the table, page 291. Such associations of olivine is unusual, and suggests early secretions.

PROF. RUSSELL'S COLLECTION FROM ST VINCENT

Professor Russell kindly sent me three specimens, one of lapilli and two of dust, "that fell on May 7, 1902. These samples represent fresh material erupted from La Soufrière." The lapilli had the following label: "Average sample of material which well at Georgetown, St Vincent, on May 7, 1902. The material of this nature which fell ranges in size from fine dust up to rough fragments 5 and 6 inches in diameter. Mingled with this fresh lava are angular fragments of fine-grained, bluish compact rock, representing older terranes, which came down red hot and broke into small pieces on striking. Collected May 27, 1902."

No. 1. This specimen is about five centimeters in diameter, reddish brown, and spotted white and black, with crystals of feldspar and pyroxene. It is pumiceous, but not sufficiently light to float on water. Under the microscope it is mainly vesicular glass, containing plagioclase, apparently labradorite, with augite, hypersthene, olivine, and magnetite. The single, large olivine grain is not surrounded with hypersthene, as in the other specimens, and one large crystal of augite showing lamellar twinning has an inclosed core of pleochroic hypersthene in parallel crystallographic position.

The olivine is evidently one of the early products of crystallization, and it is remarkable that three of the four specimens from St Vincent contain olivine. They recall to my mind lapilli found among those of the final eruption at Mount Mazama of Crater Lake, Oregon, where olivine is an exceptional constituent and not found in the dacitic lava of the same eruption.

No. 2. "Volcanic dust fell at Kingston, St Vincent, May 7, 1902. Collected May 24, 1902." The dust is light gray and uniformly fine, as if well assorted during its flight from the coarse material ejected at the same time. The largest particle measured had a diameter of six-tenths of a millimeter. Many mineral particles are five-tenths of a millimeter in diameter, but the average is not more than two tenths of a millimeter.

The larger particles are of dirty glass, rarely clear, and colorless and full of bubbles. Others contain a multitude of minute crystals. Those filled with these microlites are of pulverized older rock, while the dirty vesicular glass ones like the groundmass of the pumice represent the molten magma of the eruption. The latter appear to be most abundant. The greater portion of the dust is crystal fragments of plagioclase, augite, hypersthene, brown hornblende, and magnetite. Olivine may be present, but its presence could not be demonstrated.

No. 3. "Volcanic dust; surface of deposit at Richmond House, St Vincent. Collected May 25, 1902." The material is just like that of No. 2 excepting that some of the mineral fragments are larger, reaching over a millimeter in diameter, the proportion of microlitic groundmass particles greater, and a grain of olivine was observed.

SAND AND DUST FROM BARBADOS

Beside the material collected by Professors Hill and Russell on Martinique and St Vincent, several specimens of the sand and dust were obtained at greater distances from the points of eruption. Sand and dust fell at Barbados May 7 and 8, as described elsewhere,* to a depth of three-fourths of an inch. It was supposed by eyewitnesses to have come from St Vincent, distant 90 miles directly west.

The largest particles have a diameter of about six-tenths of a millimeter and average half that size. The sand is a mixture in which crystal fragments predominate over glassy particles. Plagioclase is most abundant. Hypersthene, augite, and magnetite, and perhaps traces of other minerals, occur. An analysis of material from the same fall in Barbados was made by Dr Pollard and published by Mr J. J. H. Teall.† It is given in the table of analyses. Mr J. D. Falconer in the same journal reports "a very few crystals of brown hornblende," and T. C. Porter mentions dark-colored mica and olivine, but from his description the latter is most likely hypersthene.

The presence of augite in considerable quantities supports the view expressed above that the sand came chiefly, if not wholly, from La Soufrière, on St Vincent.

DUST FROM THE STEAMSHIP COYA

The British steamship *Coya*, on the evening of May 7, encountered a shower of volcanic dust 275 miles southeast of

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*Science, June 13, 1902, p. 947.

†Nature, June 5, 1902, p. 130.

St Vincent, and through the U. S. Weather Bureau the U. S. Geological Survey received the material for study. As described in *Science*,* it differs from that of Barbados only in the smaller size of particles and a relatively larger proportion of vesicular glassy to crystal fragments. The greater the distance the more important relatively becomes the vesicular glassy particles which represent the molten material of the eruption of La Soufrière, although even at a distance of 275 miles the crystalline matter is still in excess of the glassy. For the purpose of comparison, Mr Steiger's chemical analysis is quoted here with a hypersthene augite andesite of Crater Lake, Oregon, in the following table.

In an endeavor, if possible, to get a notion of the destructive gases which wrought such havoc at St Pierre, this dust was treated with a large amount of water for two hours on a water bath. An analysis of the solution thus obtained by Mr Steiger is given in column 7 in the table of analysis, indicating that the substances dissolved were $CaSO_4$ and NaCl. These are common substances in sea water, and it might be argued that they prove that sea water played an important part in the eruption. As the $CaSO_4$ is much in excess of the NaCl, they cannot be attributed directly to sea water, but more likely to the presence of the acids HCl and SO_2 in the presence of steam acting upon the lime-soda feldspar and forming the compounds recognized in solution.

The analyses of the insoluble portion given in column 6 of the table shows a considerable percentage of S present, but apparently not in a free state. It may be in the form of pyrrhotite, as suggested by Mr Hillebrand, but we were unable to prove it. Sulphides are rare in fresh volcanic rocks, although they may become common in altered forms. For purposes of comparison an analysis of a hypersthene augite andesite from Crater Lake, Oregon, is given in column 8.

In comparing these analyses it must be borne in mind that, while Nos. 1 and 4 represent the composition of the molten magma in Mont Pelée and La Soufrière respectively, the sand and dust are made up chiefly of comminuted older rocks, mixed with a portion of the lately erupted magma, and would not give necessarily reliable results as to the composition of the magma. However, it so happens that, the older rocks being of approximately the same chemical composition as that of the lately active magma, the composition averages nearly the same.

Dust spread so far and wide from the great eruption of Krakatoa was composed almost wholly of material from the molten magma of eruption. It was composed almost wholly of fragments of pumiceous glass, with a few associated crystals. Comminuted older lavas formed scarcely an appreciable part of Krakatoan dust, while at Bandai-san, Japan, in 1888, according to Y. Kikuchi,* "of lava or pumice there is no trace." All of the material ejected was decomposed and comminuted lavas of earlier eruption. The dust from the late eruption of Martinique and La Soufrière, collected at a great distance from its source, is nearly midway between these two extremes.

SUCCESSION OF LAVAS

Among the volcanoes of the western United States, especially in the Cascade Range, the succession of lava has been determined at a number of places. The earlier eruptions from the large vents are uniformly andesite of one form or another, but generally hypersthene andesite. Later came basalts from craters about the base of the cone marking the site of the principal vent, and these were often succeeded in the principal vent by dacites or rhyolites. The series is well illustrated at Lassen Peak, less completely at Mt Shasta, but especially well in Mt Mazama, about Crater Lake. With this succession in mind we may surmise the order in the volcanoes of Martinique and St Vincent.

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*Science, June 13, 1902, p. 947.

*Journal of the College of Science, Imperial University, Japan, vol. iii, part ii, p. 141.

LAVAS OF CARBET PEAK

Upon the northern end of Martinique are two peaks which have been volcanoes, and each has its succession of lavas. Mont Pelée is still active, but Carbet, according to Mr Hill, has long since ceased erupting and is now deeply eroded.

From Mount Carbet seven specimens were obtained. Three (Nos. 9, 12, and 15) from the base are hypersthene andesite, but one of them (15) contains some prominent crystals of hornblende. From a ravine in the upper slope of the plateau comes a well-marked hornblende andesite (No. 3*b*) and a hypersthene andesite (3*a*), with a trace of augite, while the "material of the peaks" is (4) dacite; but, judging from the order among the volcanoes of the Cascade Range, the dacite is possibly youngest. Against this view, however, is the very altered condition of one specimen (20) of dacite. Considering that the volcanic vent of Carbet has furnished not only andesites with hornblende and hypersthene, but also dacite, basalts might well be expected to occur on the periphery of the same vent.

LAVAS OF MONT PELÉE

The series of lavas of Mont Pelée is less complete, but how much is due to lack of complete collection is not known. Nine specimens were obtained, among which three (2, 5, 13) are hornblende-bearing hypersthene andesites, one augite hypersthene andesite, and four hypersthene andesites, one of which belongs to the fresh eruption. The differentiation of the magma has not yet completed its cycle and there is no definite evidence that it ever will.

LAVAS OF LA SOUFRIÈRE, ST VINCENT

The number of specimens from St Vincent is small. They all belong to hypersthene andesites, but are remarkably abnormal in containing olivine. How general this feature may be can only be surmised from the number of olivine-bearing specimens. Three of the four specimens contain olivine, and the fourth may contain it also, although not shown in the thin section. The olivine was one of the early minerals to crystallize in the magma, and its occurrence here may be attributed to some peculiar condition. It recalls the more or less sporadic occurrence of quartz in basalt, which in some cases,* for example the Cinder Cone, 10 miles northeast of Lassen Peak, California, becomes a general feature of the erupted mass.

For more thorough study of the petrography of the recent eruptions of Martinique and St Vincent we must look to Prof. T. A. Jaggar, who is spending sufficient time upon the ground to make extensive and complete collections.

VOLCANIC SMOKE AND ASHES

Volcanoes are popularly referred to, even in scientific circles, as "smoking" and ejecting "ashes," but it should be understood that the terms do not express the same process or product ordinarily associated with chimneys.

Some form of organic carbon compound, as wood, coal, oil, or gas, is the common source of light and heat, and the smoke results in large part at least from the imperfect contribution of the carbon, which is black. The heat evolved is of combustion in the oxygen of the air, and the ashes are the residue left after the separation of the carbon compounds.

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* U. S. Geological Survey, Folio 13 and Bulletin 79.

In the volcanic process, however, there is no combustion of carbon, nor black smoke due to unconsumed carbon. The so-called smoke is chiefly steam clouds rendered dark or black by *lapilli*, *sand*, and *dust*, particles of solid rock matter such as those that fell at Barbados from St Vincent.

CHEMICAL DISCUSSION OF ANALYSES OF VOLCANIC EJECTA FROM MARTINIQUE AND ST VINCENT

BY W. F. HILLEBRAND

SEVERAL of the chemical analyses of the foregoing paper by Dr Diller were only completed after his report had gone to the printer, and are hence not utilized in his discussion. There are several features connected with these and other analyses that have appeared in print which are suggestive, and it may be worth while to call attention to them at this time. The data at hand are not sufficient to warrant positive conclusions, but on their face certain probabilities appear to be indicated.

Aside from the five analyses made by chemists of the Geological Survey, the only one of much value that has come under my observation is that by Dr Pollard in *Nature*, page 130 (No. 5 of Dr Diller's table). This, while less siliceous than any of the others, and high in lime and magnesia, is in nearly every respect confirmatory of the others of like type. The exception will be referred to later (page 299). The three following analyses are incomplete and unsatisfactory, and only of service in a general way. For convenient reference they are reproduced here:

	(*a*)	(*b*)	(*c*)
SiO_2	53.34	51.60	53 40
Al_2O_3	30.68	21.12	21.00
Fe_2O_3		9.28	9 50
CaO	10.47	9.07	9.70
MgO	4.12	3.96	2.00
Na_2O		0.59	2 33
K_2O		0.81	0.85
SO_3		0 89	0.90
S	.17		0.90
P_2O_5	Trace.	.19	0 25
Ign. loss		1.20	
Undet.		1.29	
	98.78	100.00	99.93

a. "Mineral dust from the Martinique eruption," which fell on board the *Alesandro del Bueno*, about 100 miles from St Pierre (date and location not given). *Science*, June 6.

b. Volcanic dust which fell over the Barbados on May 8. *Chemical News*, June 13.

c Volcanic dust collected from deck of steamship *Roddam* on her arrival at St Lucia. *Chemical News*, June 13.

If we consider now the six most complete analyses, those of Diller's table, they appear chemically to fall into two groups, one from Pelée, on Martinique, the other from Soufrière, on St Vincent. The distinct characteristics are these: Higher silica and potash, with, in general, lower alumina, total iron, lime, magnesia, and titanium in the ejecta from Pelée. The difference in titanium seems to be particularly marked and characteristic. There are, however, other differences, of which the most striking is the almost complete absence of sulphur in the Pelée ejecta, while in those from the Soufrière it is a very marked constituent, both in the sulphate and sulphide conditions. Another analysis of Soufrière dust from near Georgetown, which I myself have made, but do not feel at liberty to make public yet, emphasizes this last distinction in a much more marked manner than any of those here published.

Samples 1, 2, and 3 represent the material ejected from Pelée at certainly two different eruptions, and taken from rather widely separated points. The first is tolerably compact, only slightly vesicular pumice, which still retains much of its original water, while the other two are lapilli and dust which have lost much more of their water, presumably because of higher temperature and finer comminution. No. 3, collected on the *Potomac*, at Fort de France, on the 20th of May, about 20 miles away from the seat of eruption, shows the same effects of sifting by transportation through the air that No. 6 does in the case of St Vincent dust—that is, it probably contains more of the originally molten constituents of the magma, which would be higher in silica and alkalies than the mass as a whole. Mr Steiger's tests on the dust from the steamship *Coya* show that it not only contains oxidized sulphur, but also sulphur in the state of sulphide. My own as yet unpublished analysis of dust from Georgetown shows the same, and that the sulphide is not pyrite, but one which is readily soluble in hydrochloric acid with evolution of hydrogen sulphide. When separated from other constituents its hydrochloric solution reacts for iron. It is therefore doubtless a sulphide of iron, and I regard it as probably pyrrhotite. There is no positive evidence as yet, however, that it may not be FeS. My analyses had to be made in such haste that no opportunity has as yet offered for a nearer investigation of this interesting point, the true composition of the iron sulphide.

I may here mention an analysis of dust collected at sea off St Vincent, on the S. S. *Louisianian*, an analysis of which, by Professor Carmody, appears in the *Trinidad Mirror* of May 22. For a copy of this analysis I am indebted, through Dr Diller, to the Weather Bureau of the Department of Agriculture. It is not stated in a form which can be compared with those in this Magazine, except as to the water-soluble components. These are exactly as Mr Steiger found them to be in the dust from the S. S. *Coya*, calcium and the sulphate ions largely predominating over alkali and chlorine ions.

Now let us consider the analyses, which I have denominated *a*, *b*, and *c* (page 296), in the light of the evidence thus far accumulated.

It would seem as if the soda determination of *b* of this analysis must be faulty, for of all the other analyses it is the only one which shows less than 2⅓ per cent, while six show from 3.23 to 3.79 per cent of soda. If the potash fell off correspondingly, this suspicion might not be justified; but it does not. It is of the same order as the potash of all the other analyses that show relatively low silica. To assume that the figure given for soda in *b* is correct, means that we have here a volcanic product markedly different in composition from all the others, which, taken as a whole, are essentially alike. This is highly improbable, and I feel little doubt that the value in question is erroneous. In most other respects the analyses *b* and *c* might almost be duplicates, and they show the low silica and relatively high potash, as well as iron and magnesia, of the known St Vincent ejecta; likewise the high sulphur content, which is probably to be distributed between sulphates and sulphides, as in Steiger's analyses 6 and 7 and the unpublished one of my own. But *c* purports to have been collected from the deck of the S. S. *Roddam*, while *b* is from Barbados. How is it possible that two samples so very different in composition as *c* and No. 2 of Diller's table should have been ejected from the same volcanic vent at the same time and fallen upon the narrow deck of the same steamer? Even had this happened, it seems beyond the bounds of the possible that two samples taken at random should show such differences. Analysis *c* bears all the earmarks characteristic of undisputed Soufrière ejecta, while No. 2 is as characteristic of that from Pelée when compared with 1 and 3. Is it an unwarranted suspicion that the labels of the specimens *b* and *c*, whose analyses appear in the *Chemical News*, became disarranged, and that they either represent different analyses of the same Barbados dust, or, at any rate, that the *Roddam* dust is not really represented by *c*? It is hoped that this point can be made clear by the editor of the *Chemical News* and the chemist who made the analyses.

As to analysis *a*, the announcement in *Science* implies that it came from Pelée, but there is no proof whatsoever that this is so. The internal evidence of the analysis itself points most strongly to Soufrière as the source, and I shall so regard it until proof to the contrary is forthcoming. The sulphur is given in the original publication as such, without any statement as to SO_3; but, as in the case of 6, and probably 5, it may very well be in both sulphide and sulphate state.

The reason why 4 shows only sulphide sulphur and no sulphate is probably that, because of its being a lump of pumice, the sulphide was not so exposed to oxidation as that in the fine sand and dust, which must have been in full contact with air at a high temperature sufficiently long to permit of oxidation of a part of the sulphur.

If the above inferences are justified, we find, then, that while the ejecta from the two volcanoes are of the same general type and while the material from the same vent may vary in composition within limits, according as it is collected near to or far from the vent, and in coherent or finely divided form, yet there are characteristic differences by which it appears easy to distinguish the product of one volcano from that of the other.

Possibly, as I have already admitted, further careful investigation will not bear out the conclusions above suggested, but the evidences in their support are so strong at present that geologists and chemists will do well to put them to further and decisive proof.

The analyses afford room for speculation in other directions also. If it is true, as said, that the deaths in St Vincent resulted largely from strangulation from the fumes of sulphur dioxide, the source of this gas is not far to seek, for the magma before the eruption contained sulphide in quantity which, coming in contact, while red hot, with air, would be partially oxidized with formation of sulphur dioxide. In Martinique the testimony as to sulphur fumes in the dust clouds is overwhelming and the odor of sulphur dioxide was, under favorable conditions, perceptible miles at sea; but it does not appear to have been formed in such quantity as on St Vincent, and this stands in agreement with the great paucity of sulphide in the solid ejecta from Pelée, as shown by my analyses, which further accounts for the absence of sulphates in them. It is not, in my opinion, necessary to assume the prior existence of sulphates in the matter ejected from Soufrière, for while there may have been such near the surface, resulting from fumarolic or solfataric action, the temperature at which the sulphide came in contact with air must have been sufficiently high to effect an appreciable conversion not only to the condition of sulphurous acid, but to that of sulphuric acid as well.

In making further analyses chemists should be particular to ascertain the condition of sulphur in these ejecta, and not be content to report it simply as SO_3 without further comment. Work of this kind is worth doing well, or it were better left undone.

It may here be said that in the analyses showing much sulphide the values given for the oxides of iron are only approximate. The exact error due to the effect of a more or less soluble sulphide like pyrrhotite it is impossible to gauge, though, of course, there is no difficulty in correctly ascertaining the total amount of iron, which serves as the basis for calculating the oxides and sulphides.

Earlier in this paper I alluded to one disagreement between the analyses reported by the chemists of the Geological Survey and that by Dr Pollard in *Nature* (Diller's No. 5). This relates to the presence of nickel and cobalt. Either we of the Survey have overlooked traces of nickel because of some inherent defect in our method or Dr Pollard has counted as nickel something which was not that element. I may say, as the result of our experience of many years, that such amounts of nickel as were reported by Dr Pollard are rarely met with except in peridotitic rocks, and that hundreds of analyses of almost every other kind have been made without finding such a large amount.

Dr Porter, in *Nature*, p. 131, mentions with some reserve the finding of a trace of copper in his specimens of dust from Barbados. This observation I believe to be quite correct. I also found it in the three specimens from Pelée, just as we find it in nearly every rock analysis that is made in the Survey laboratory. We seldom report it because of the opportunities usually present for its introduction from outside; but my personal belief is that it is as universally distributed through rocks as any one of the other metals, though of course in very small amounts.

Some of the points referred to in this paper may with advantage be dwelt upon at greater length in a future publication, when further data are available for examination and discussion.

REPORTS OF VESSELS AS TO THE RANGE OF VOLCANIC DUST

COMPILED BY JAMES PAGE, U. S. HYDROGRAPHIC OFFICE

FROM the log of the barque *Beechwood*, Dennison, master; Salaverry to New York:

"May 8, latitude 13° 22′ N., longitude 49° 50′ W. (Mont Pelée W. by N., 660 miles), wind E. N. E., force 4; sky overcast and tinted a buff color; fine gray dust began to fall at noon.

"May 9, latitude 14° 46′ N., longitude 51° 27′ W. (Mont Pelée W., 540 miles), wind E. N. E., force 4; sky cloudy; dust ceased falling about noon.

"On my reference to a chapter in the directory called 'An account of the fine dust which often falls on vessels in the Atlantic, and which comes from the

Desert of Sahara,' I found there was no account of its having been seen so far west, so I bottled a sample of it. On my arrival in New York and hearing of the volcanic eruption at Martinique, I concluded it came from there, although we were 600 miles to windward of that island."

From the log of the steamship *Louisianian*, Captain D. Edwards, Liverpool to Trinidad, April 25 to May 9, 1902 :

"Arrived in Carlisle Bay, Barbados, May 7, at 11 a. m. (Martinique N. W., 140 miles), the weather being fine and clear. Between 1 and 3 p. m. reports as of heavy artillery firing were heard, and shortly afterward a dense black cloud appeared in the west, in the direction of St Vincent (W. 100 miles), and gradually moved toward E. S. E. At 4 p. m. the whole sky was overcast, except a low arch to the northward. At 4.30 light showers of dust began to fall, and it was so dark that lights had to be burned on the ships and ashore. At 5.30 we departed for Trinidad (Port of Spain), the weather being so dark that we could not distinguish a large mooring buoy at a distance of 40 yards. At this time the rain dust was pouring down and speedily covered the decks to the depth of a quarter of an inch. About 10 miles from Carlisle Bay the dust was so dense as to cause almost total darkness, and during this time it thundered and lightened, the lightning being of a dull-red color. From 7 p. m. to 9 p. m. the dust kept falling thickly ; at 9.30 the thunder ceased and the dust showers diminished ; at 11 p. m. it commenced to clear to the southward and the stars were occasionally visible. We steamed through this rain of dust for a distance of 90 miles in a direct line from Barbados to Trinidad, and at a low estimate 1 inch of dust fell on the decks. From 5.30 p. m. the wind was north, light, until 2 a. m. ; after which it was S. E., gentle."

From the log of the barque *Ethel Boynton*, Captain J. W. Cates ; Philadelphia to Cartagena, May 11 to June 2, 1902 :

" The only thing unusual noted during the passage was the discolored water from Mona Passage (Martinique E. S. E., 400 miles) southward through the Caribbean Sea to latitude 15° N., the water throughout the stretch being of a dark grayish tint and carrying small particles, which appear to be volcanic ashes. To the southward of 15° the water assumed its natural deep blue."

From the Government Laboratory, St Johns, Antigua (Martinique S. S. E., 150 miles), C. H. G. Sprankling, observer :

" During the period of volcanic activity in the southern islands there has been nothing in the atmospheric conditions here to connect with the disturbances."

Log of ship *Lena*, Nibbs, master, Barbados to New York :

" While at Barbados a heavy rain of volcanic dust fell from Mount Soufrière (W., 100 miles) on the decks and awnings of the vessel. Seven tons of same were thrown into the hold for ballast."

Log of the S. S. *Coya*, Thomas, master, Montevideo to New York :

" May 7, 10.30 p. m., latitude 11° 23′ N., longitude 57° 52′ W. (Martinique N. W., 300 miles ; St Vincent W. N. W., 250 miles). During the afternoon a heavy bank commenced rising in the north, which by 10.30 p. m. covered the whole sky. At the same time a fine gray substance commenced falling, which by 8 a. m. of May 8 covered the decks to the depth of an eighth of an inch. The wind during the incident was east, moderate; sea smooth."

Log of the barque *Eleanor M. Williams*, Corbett, master; Conetable Island to New York :

" May 8, 1902, latitude 14° N., longitude 57° W. (Martinique W., 250 miles). Fine weather, sky overcast. During the first part of the night heard a very low moan, like thunder, in the S. W., and from 3 to 8 p. m. had a very heavy shower of ashes, covering rigging, sails, and deck. The cloud dark like a rain cloud, with changeable temperature—sometimes warm, some times cold—the sun having a reddish color and the air a dealy smell ; the ashes resembling gray cement."

Log of the ship *Anaurus*, Henderson, master, Portland, Oreg., to Queenstown:

"May 9, 1902, latitude 4° N., longitude 32° W. (Martinique W. N. W., 1,800 miles). A violent vibration was felt throughout the ship for about 30 seconds, as if going over the top of something, supposed to be the effect of a submarine earthquake."

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THE NATIONAL GEOGRAPHIC MAGAZINE

PROBLEMS OF THE PACIFIC—THE COMMERCE OF THE GREAT OCEAN*

BY HON. O. P. AUSTIN,

CHIEF OF BUREAU OF STATISTICS, TREASURY DEPARTMENT

THE problem of the Pacific, from the commercial standpoint, seems at first sight a difficult one. To transport commerce across a great ocean which stretches literally half way round the globe is no small undertaking. And to do this in competition with countries lying thousands of miles nearer to that great and exacting market of the Orient is a task which would scarcely be undertaken by other than American energy and by the descendants of those older commercial nations—England and Germany—whose ships now penetrate every sea, and whose commercial representatives are found in every country. Even American energy and commercial enterprise have looked askance at this great task during the years in which the problems of the home market and home development were under consideration. Railroads were needed to develop the great interior of our own country, and their construction was followed by the development of the farms and forests and mines of the great interior and the manufacture of the natural products with which this great country had been so lavishly endowed.

But these great undertakings have been accomplished. The country has been gridironed with railroads. Six great transcontinental lines connect ocean with ocean, and others connect the Lakes with the Gulf, while their lateral branches leave scarcely a material section of the country without direct and cheap transportation to the water's edge. The producing areas thus opened, whether agricultural, forest, or mining, have poured out their treasures; the ready capitalist and the busy workman, aided by the genius of the scientist and the inventor, have turned these natural products into form ready for consumption. The great home market has been supplied, and the producer, the manufacturer, and the capitalist are now seeking new worlds to conquer. The boundless energy which constructed railroads, developed farms, opened mines, invaded forests, and constructed factories, having succeeded beyond its greatest expectations, now turns its attention to the next great problem, that of finding in other countries a market for the ever-increasing surplus which that energy is producing at home.

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* An Address before the National Geographic Society, April 2, 1902.

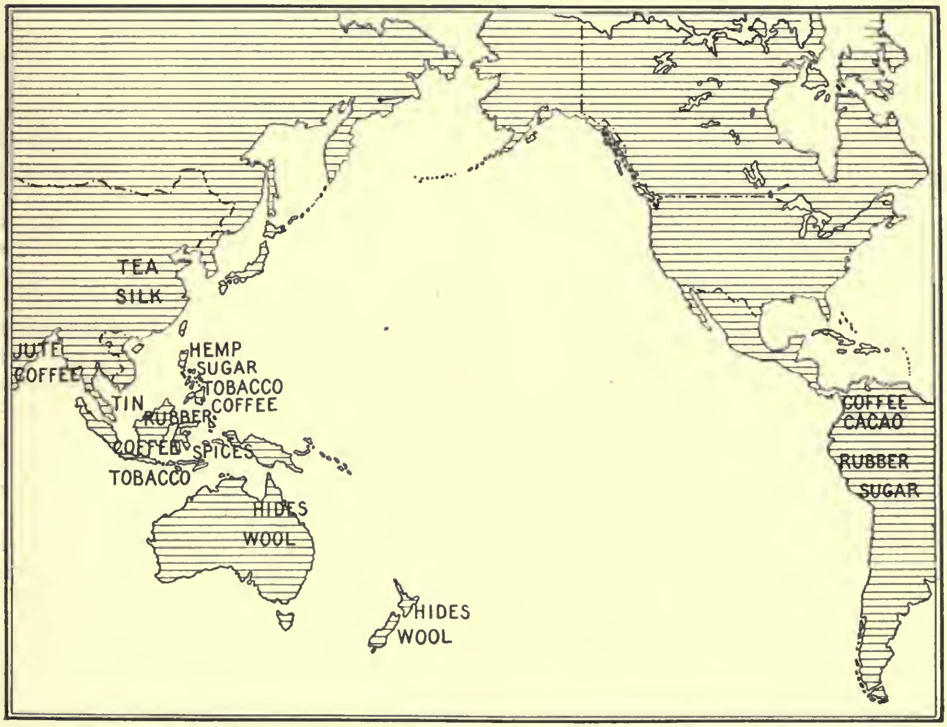
In addition, however, to these products of our fields, and mines, and forests, and factories, there are certain articles required for use in manufacturing and for food and drink which we do not and probably cannot produce at home. The raw silk, and fibers, and rubber, and cabinet woods, and chemicals, and dyestuffs for use in manufacturing; the tea, and coffee, and cocoa, and sugar, and rice, and tropical fruits and spices required as food and drink, must be supplied in part or in whole from abroad, and they form and must continue to form an ever-increasing part of our imports. We bring every day in the year a million dollars' worth of these tropical and subtropical products from other countries. We want to pay for these necessities of daily life—necessities which we cannot produce at home—with the products of our farms and mines and forests and factories, and also find a market for the hundred millions of dollars' worth of our surplus that still remains after paying for all these necessary imports.

It is because of these conditions, increasing in intensity as our surplus grows and our demand for tropical goods in exchange also grows, that we are looking abroad with increased interest and anxiety every day, that our manufacturers and merchants are building and buying ocean fleets, that our capitalists are extending their cable lines to distant countries and islands, that our producers are demanding an isthmian canal, and that our people are commanding the ownership by the United States of tropical gardens which may in time supply many of the articles which we now buy in foreign countries and open new markets for our own productions. And it is to the Pacific that we naturally look for this growth of our commerce. Europe is, of course, the natural market in which to sell our foodstuffs and the materials used in manufacturing, and we are also making good headway there with certain classes of our manufactures; but it is from the countries bordering upon the Pacific that we draw a large share of our tropical and subtropical imports, and among their enormous population—one-half the population of the world—we should find a large market for our surplus breadstuffs and meats and manufactures.

But the exchange, under present conditions, is not easy. Our great producing and consuming centers still lie in the eastern half of the continent, and while we have a magnificent system of railroads connecting them with the Pacific coast, the relative cost of transportation by rail is so much greater than that by water that we cannot expect to successfully compete in the struggle for this Pacific commerce until direct water transportation is supplied between the initial points of production and consumption. Recent estimates of the cost of transporting freights on the Great Lakes compared with that on the railways of the country showed that the average rate per ton per mile was *just one-tenth* as much on the Lakes as on the railroads. While this is doubtless an extreme case, owing to the fact that the Lake freights were chiefly grain, iron ore, and coal, and the average distance between points of shipment and discharge greater than that of the average rail shipments, there can be no doubt that the cost of water transportation *is* much less than that by rail, even under the most favorable conditions for the latter. A *single ocean vessel* of modern capacity will carry as much as 400 railway cars, or 20 trains of 20 cars each; and as a consequence the country which can send its products by water, from the door of the factory to the door of the consumer on the other side of the globe, is at a great advantage over that which must send its products two or three thousand miles by rail, before placing them upon the vessel which conveys them to the consumer.

Our present all-water routes from the eastern coast to the Orient are 12,500 miles *via* the Suez Canal, 15,000 miles via Cape of Good Hope, and over 16,000 miles *via* Cape Horn and the Pacific; or one-half the distance round the globe if *via* the Suez, and two-thirds the distance around the globe if *via* Cape Horn. Nevertheless, about two-thirds of our commerce with Asia and Oceania still goes across the Atlantic Ocean, rather than undergo the expense of rail transportation to the waters of the Pacific on our own western coast. The disadvantage under which we thus labor in an attempt to compete with our European rivals for the trade with the Orient is shown in the fact that while the distance traversed by a vessel passing from New York to Shanghai is from 12,500 to 16,000 miles, the distance from London to Shanghai is but about 10,500 miles, an advantage to the British merchant of from 2,000 to 5,000 miles, according to the route of the vessels from New York.

In spite, however, of the disadvantage under which our merchants labor in their attempts to cultivate commercial relations with the Orient, our actual commerce with the islands and countries of the great Pacific has grown rapidly in recent years, and more rapidly than that of any other nation. Our imports from Asia and Oceania increased from



Map No. 1. Principal Productions of the Countries Fronting on the Pacific (see page 307)

105 millions in the calendar year 1891 to 162 millions in 1901, an increase of over 50 per cent, while the total imports of the country were increasing but 10 per cent. Our exports to Asia and Oceania increased from 40 millions in 1891 to 115 millions in 1901, an increase of 180 per cent, while the total exports were increasing but 50 per cent.

This brings us to a consideration of the Pacific and its commercial conditions today and its possibilities when we shall obtain access to it through an Isthmian canal, which we may reasonably expect we are soon to have. Before entering upon a detailed discussion of this, however, it is proper that we should realize the enormous extent of this great body of water—its length and breadth and its comparison in area with that ocean with which we are much more familiar, the Atlantic. The superficial area of this great ocean is 60 million square miles, or 20 times that of the United States, exclusive of Alaska, and it covers more than one-fourth of the entire surface of the earth. Its enormous size will be better realized when we remember that the distance across it at its widest point, where our vessels cross it in the journey to the Orient, is four times as great as that across the Atlantic from New York to Liverpool, and seven times as great as across the Atlantic at its narrowest point, from Pernambuco, Brazil, to Freetown, Africa. The contrast between the great circular Pacific, which vessels must occupy weeks in crossing, and the long, narrow Atlantic, which we are accustomed to ferry as a holiday pastime, can be better realized when they are studied side by side without reference to the great bodies of land adjacent. The Atlantic meanders like a river between Europe and America, spanned by a dozen cable lines and innumerable steamship routes; the Pacific stretches half-way round the globe, with a few island way stations, where the sailing lines converge, in order that the vessels on this long route may take advantage of them as ports of call for repairs, for coal, for water, and for communication with mankind.

These things are not altogether encouraging to the utilization of the Pacific as a highway for commerce, or an exchange of commodities with nations on the other side of its waters. In fact, they appear rather discouraging in some of their aspects, and there are persons who doubt the feasibility of conducting commerce at such long range when the markets of Europe and South America are so much nearer, while others even doubt the advisability of expending a couple of hundred millions in the construction of a canal to give us access to its waters.

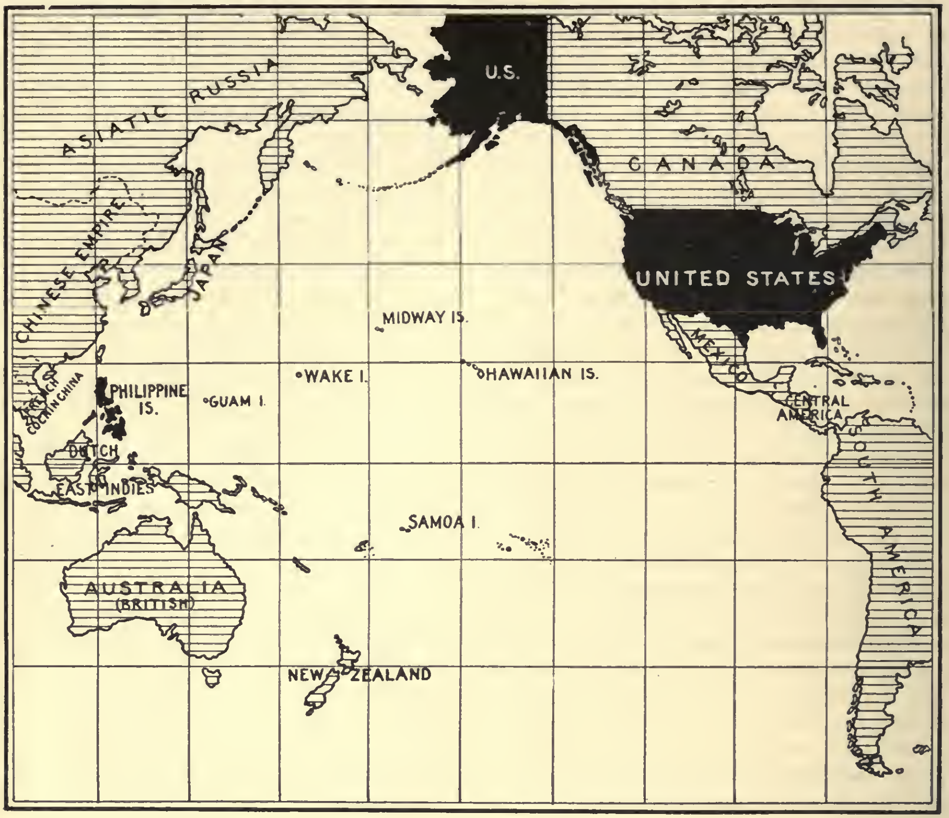
But there is another side of the picture, and one which we must carefully consider: *First.* The countries on the other side of this great ocean produce the articles which we must buy abroad—articles absolutely required by our people, and which we cannot, or at least do not, produce at home. *Second.* These same countries are buying *a hundred million dollars' worth of merchandise every month of every year*, and most of it is the class of goods which we want to sell. *Third.* The United States has greater and better facilities for utilizing this great ocean as a highway of commerce than any other nation has or *ever can have.* This last statement may seem a somewhat startling one, but I shall show you that it is justified, and that conditions provided by nature, and which cannot cease to exist as long as the earth revolves, give to our country exceptional facilities for commerce with the countries fronting upon or contiguous to the Pacific Ocean.

These three great propositions which I have just named I now propose to take up in the order in which they are mentioned.

The countries bordering upon the

Pacific supply in great quantities the articles which form and must always form the bulk of our imports. However much we may encourage and desire to encourage home production, there are certain articles required for food, drink, and manufacturing which we must always import in increasing quantities as our population grows and the products of their workshops are multiplied. The manufacture of silk in our own factories has increased enormously, but the supply of the raw material is entirely drawn from abroad, and the importation of raw silk has grown from a half million pounds in 1870 to over 12 million pounds in 1901; and in no part of the world is silk produced so successfully as in the countries bordering upon the Pacific. The importation of fibers for use in manufacturing has grown from less than 100 million pounds in 1870 to nearly 600 million pounds in 1901, and the best qualities of fibers come from the countries and islands fronting upon or adjacent to the Pacific. India rubber importations for use in manufacturing have grown from less than 10 million pounds to 55 million pounds during the same period; and the countries and islands fronting upon the Pacific are increasing their production of this article. Tea imports have increased 50 per cent since 1870, and practically all of the world's tea comes from the Orient. Coffee importations have grown from 235 million pounds in 1870 to over a billion pounds in 1901, and the best coffee that the world knows comes from the islands of the Pacific. Sugar importations have increased from a little over a billion pounds in 1870 to 4½ billion pounds in 1901, and about one-third of this now comes from the Pacific countries and islands; and the production there is capable of *indefinite* increase. While it is probable and to be hoped that our own people will in time produce their own sugar, it is our duty to consider present conditions and those of the near future in determining the source of supply of this very important article, the importation of which alone amounted to $100,000,000 in value last year. To this list of articles for which we rely upon the tropics, I might add many others, such as tropical fruits and nuts, vegetable oils, spices, cabinet woods, dyes and dye-woods, gums and numerous others. Our total importation of tropical and subtropical products last year amounted to almost $400,000,000, or nearly one-half of our total importations. The importance of having a close commercial relationship with the countries producing the great articles which we so largely import and must always bring from abroad will be better realized when it is remembered that the United States consumes practically one-half of the cane sugar produced in the world, more than one-half of the world's production of coffee, nearly one-half of its production of India rubber, and about one-fourth of its production of raw silk. On the other hand, the equal importance to these Asiatic countries of a close trading relationship with the United States is also found in the fact that these articles which we must have form their chief products for exportation, and that they naturally desire to be in close commercial relationship with the country which is the greatest consumer of their chief products for exportation. For these reasons the establishment of direct transportation routes and close commercial relations is of equal importance to the Orient and to the consumers of the United States.

Turning now to the question of the market offered to our producers and manufacturers, we find conditions in the Orient equally important. Imports into the countries fronting upon and adjacent to the Pacific, other than the United States, aggregate nearly as much as the entire exportations of this country. The imports of China are, in round terms, 190 million dollars; Japan, 140



Map No. 2. National Frontage and Way Stations on the Pacific (see page 311)

millions; Straits Settlements, 150 millions; Australasia, 250 millions; India, which, while not strictly a Pacific country, is in easy reach from its western waters, 300 millions, while adding to these Asiatic Russia, Korea, French Indo-China, Siam, Ceylon, the Dutch East Indies, the Philippines, and Hawaii, the total reaches about one billion three hundred millions. To this we must add, in a statement of the business of the Pacific, the commerce of the American countries fronting upon that ocean, which would bring the total imports, exclusive of those of the United States, up to nearly a billion and a half dollars. Of this vast aggregate of imports a very large share is of the class of materials for which our producers and manufacturers are seeking a market. Of the imports of China, over one-third are cotton manufactures, another third miscellaneous manufactures, including machinery, iron and steel manufactures, and mineral oils, while fish, flour, and canned goods also form a considerable share of the total. In Japan raw cotton, of which we are the world's chief producer, forms the largest item, while manufactures of iron and steel, flour, machinery, engines, kerosene oil, and tobacco also form important factors in the grand total. In Australasia cotton and woolen goods, manufactures of iron and steel, machinery of all kinds, especially agricultural, cars, engines, and other material for railways, manufactures of leather—in fact, nearly every class of manufacture for which we are seeking a market—enter into and make up the grand total of the very large and constantly growing importations. In British India cotton yarns and cloths, clothing, machinery, metals, hardware and cutlery, railway cars and carriages, engines, and mineral oils form the bulk of the imports. In the other countries and islands, whose imports aggregate a large sum, the class of goods imported is similar to those already named, and are almost exclusively of the class for which our people are seeking a market. Upon the map now presented are shown the figures of the commerce of each of the principal countries of the Orient.

Thus it will be seen that the commerce, present and prospective, of the Orient and the United States may properly be termed complemental: the Orient produces the articles which we must have, and is in many cases the world's chief producer of those articles, while on the other hand it demands, in ever-increasing quantities, the articles which we produce and desire to sell.

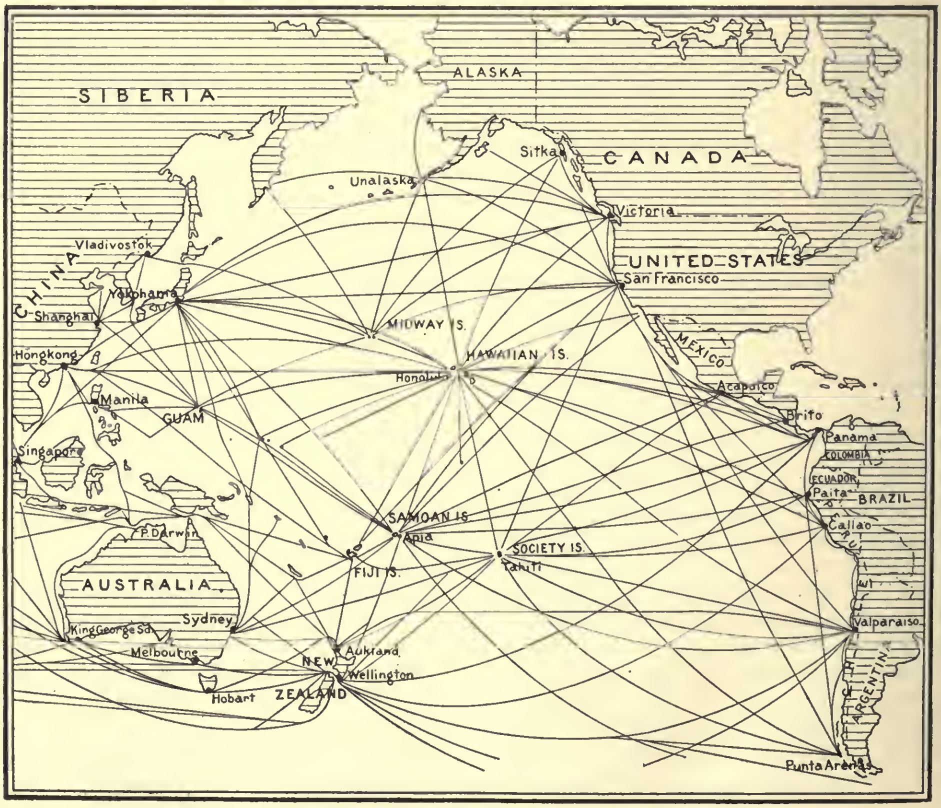
Having thus shown that the Orient produces the world's chief supply of the articles which we must always import, and that its chief importations are of articles which we desire to export, I propose to consider the share which we now have in supplying those articles and whether we are succeeding in the attempt to compete with other nations for that trade.

This may be fairly tested by taking the total imports of those countries at decennial periods and learning the share of those imports which were drawn from the United States and the share drawn from our chief rival for that trade—the United Kingdom. I have chosen for the first measurement of that commerce the year 1868, because it immediately preceded the opening of the Suez canal, which occurred in 1869, and by comparing the commerce of that year with that of later dates we may at the same time determine, in some degree, the effect of that artificial waterway upon commerce with the Orient.

In this calculation I have included the commerce of that great semicircle of countries having the Philippines as a central point—China, Japan, Korea, Hongkong, French East Indies, Siam, the Straits Settlements, India and Ceylon, British Australasia, the Dutch East Indies, and the Philippine and Hawaiian Islands—their total population being about half that of the entire globe. I find that the imports of those countries which were, in round terms, 575 millions in 1868, increased to 760 millions by 1880, to 1,025 millions in 1890, and 1,260 millions in 1900, while their exports grew from 588 millions in 1868 to 1,275 millions in 1900, their total commerce having thus considerably more than doubled since the opening of the Suez canal. But this is not all. In this great increase of commercial activity in the Orient, this "awakening of the East," the United States, although at a disadvantage from lack of direct water communication, has made phenomenal gains. In 1868 the countries which I have named took less than $8,000,000 worth of their imports from the United States, or less than 2 per cent of the grand total of their imports.

By 1880 they had increased that sum to over 30 millions; in 1890 it was more than 60 millions, and in 1900 over 110 millions, or about 14 times as much as in 1868, and forming 10 per cent of the grand total of their imports, instead of 2 per cent, as in 1868. At the same time we dealt generously with them in our purchases of their raw silks, and teas, and rice, and sugar, and tobacco, and spices; and their exports to the United States grew from 22 millions in 1868 to 162 millions in 1900. Meantime their imports from the United Kingdom, our chief rival in that trade, increased from 310 millions to 462 millions, an actual gain of about 150 millions, while the United States, despite her disadvantages in longer water routes, was gaining over 100 millions. Stated in percentages, the contrast as to growth is much more striking, even startling, the increase being for the United Kingdom about 50 per cent, and for the United States more than 1000 per cent. Even with this rapid gain, however, we are still supplying but about 10 per cent of the imports of the Orient, while our European rivals supply about 50 per cent.

Having thus shown, as it seems to me, that the countries bordering upon the Pacific produce the articles which we require; that they require, in exchange, the articles which we produce and desire to sell; that our share in the supplying of that trade has increased more rapidly than that of our chief rivals, and that a large market still remains for us to supply when we have direct access to it, I come to the final proposition, namely, that with proper access to the Pacific we shall have greater and better facilities for conducting commerce with them than any other nation. In support of this proposition I propose to show: *First.* That we have a greater coast line and more and better harbors on the Pacific than any other nation; *Second.* That we have more railway lines to serve as land carriers for that commerce than all the other countries

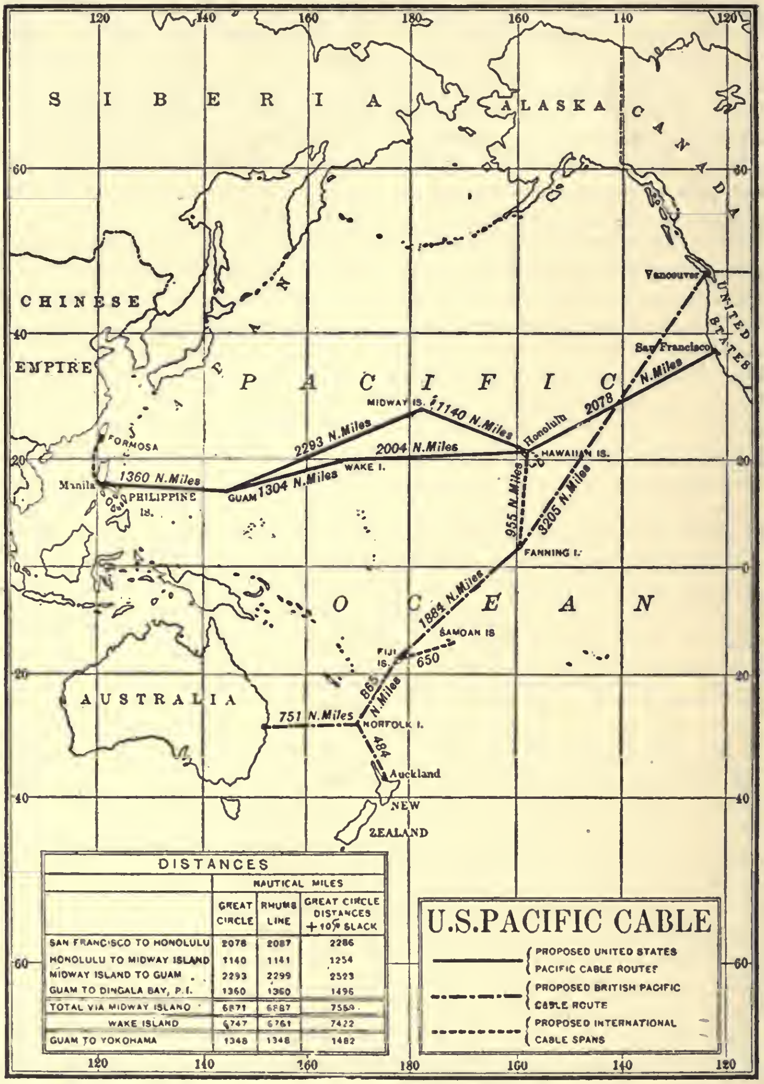


Map No. 3. Transportation Routes of the Pacific (see page 313) put together; *Third.* That we own the chief way stations of commerce on that ocean, the island ports of call which are important in an ocean of such vast distances; *Fourth.* That we control the best and nearly the only practicable route on which to lay submarine cables across the ocean—an important factor in a consideration of its commercial possibilities; *Fifth.* That at Manila we have an extremely valuable distributing point for commerce for all parts of the Orient; and *Sixth.* That nature has given to the North American continent great and remarkable advantages for commerce across this ocean—advantages which must continue to exist as long as the continent and the ocean continue in their present relation.

In support of the first of these propositions I present a map showing the coast line of the principal nations having a frontage upon and harbors in the Pacific. It will be seen that our Pacific coast line is not only much longer than that of any other nation, but that in its relation to the great producing land masses of the Temperate Zone it far exceeds that of any other single country. A statement kindly furnished me by the Coast and Geodetic Survey shows that the national frontage upon the Pacific, considering only the number of nautical miles to be protected, patrolled, or lighted, is: United States, 12,425 miles; United Kingdom, 9,975 miles; Russia, 6,260; Japan, 4,590; China, 3,130; Netherlands, with her numerous long and narrow islands, 10,860; Mexico, 3,280; Chile, 2,460, and Peru, 1,530 miles. This magnificent Pacific frontage of the United States stretches, with but a comparatively small interruption, from Mexico to the northernmost boundary of the Pacific, thence by the Aleutian Islands almost to the northern limits of Japan, while just south of Japan's possessions our Philippine Islands again stretch for more than a thousand miles along the Asiatic coast. Add to these our island possessions in the midst of the Pacific, containing, as they do, the best island harbors of the entire ocean, and it will be seen that we are justified in the statement that the United States possesses more coast line and better harbor facilities than any other nation fronting on the Pacific.

The second proposition—that we have better railroad facilities for transporting commerce to and from the water's edge—it is hardly necessary to discuss, but it can be better realized by a momentary study of a map showing the railroad lines stretching inland from the eastern and western coasts of the Pacific. Russia has a single great railroad line penetrating the interior from the Pacific coast, but it traverses a country still undeveloped and with a comparatively small population; and while our nearer neighbor, Canada, has a single transcontinental line, the United States has six distinct lines connecting the Pacific with the magnificent system of railway lines in the Mississippi valley and the Atlantic seaboard. In the other countries fronting upon the Pacific the railroads leading inland from the ocean are so few and short that they are scarcely to be considered in comparison with our magnificent railway system, whose lines aggregate 200,000 miles, or eight times the circumference of the earth at the Equator.

My next proposition, as to our advantages in the Pacific, is that we own its chief way stations of commerce, the principal islands and harbors in the great midocean. In a comparatively narrow ocean, like the Atlantic, this is of less importance, but in an enormous body of water, stretching half-way round the globe, on which vessels must sail for weeks in passing from one shore to the other, the value of islands midway, and especially along natural routes of commerce, is very great. As harbors of refuge, ports for repairs, coaling, water



DISTANCES

	NAUTICAL MILES		
	GREAT CIRCLE	RHUMB LINE	GREAT CIRCLE DISTANCES + 10% SLACK
SAN FRANCISCO TO HONOLULU	2078	2087	2286
HONOLULU TO MIDWAY ISLAND	1140	1141	1254
MIDWAY ISLAND TO GUAM	2293	2299	2523
GUAM TO DINGALA BAY, P. I.	1360	1360	1496
TOTAL VIA MIDWAY ISLAND	6871	6887	7559
WAKE ISLAND	6747	6761	7422
GUAM TO YOKOHAMA	1348	1348	1482

U.S. PACIFIC CABLE

PROPOSED UNITED STATES PACIFIC CABLE ROUTES

PROPOSED BRITISH PACIFIC CABLE ROUTE

PROPOSED INTERNATIONAL CABLE SPANS

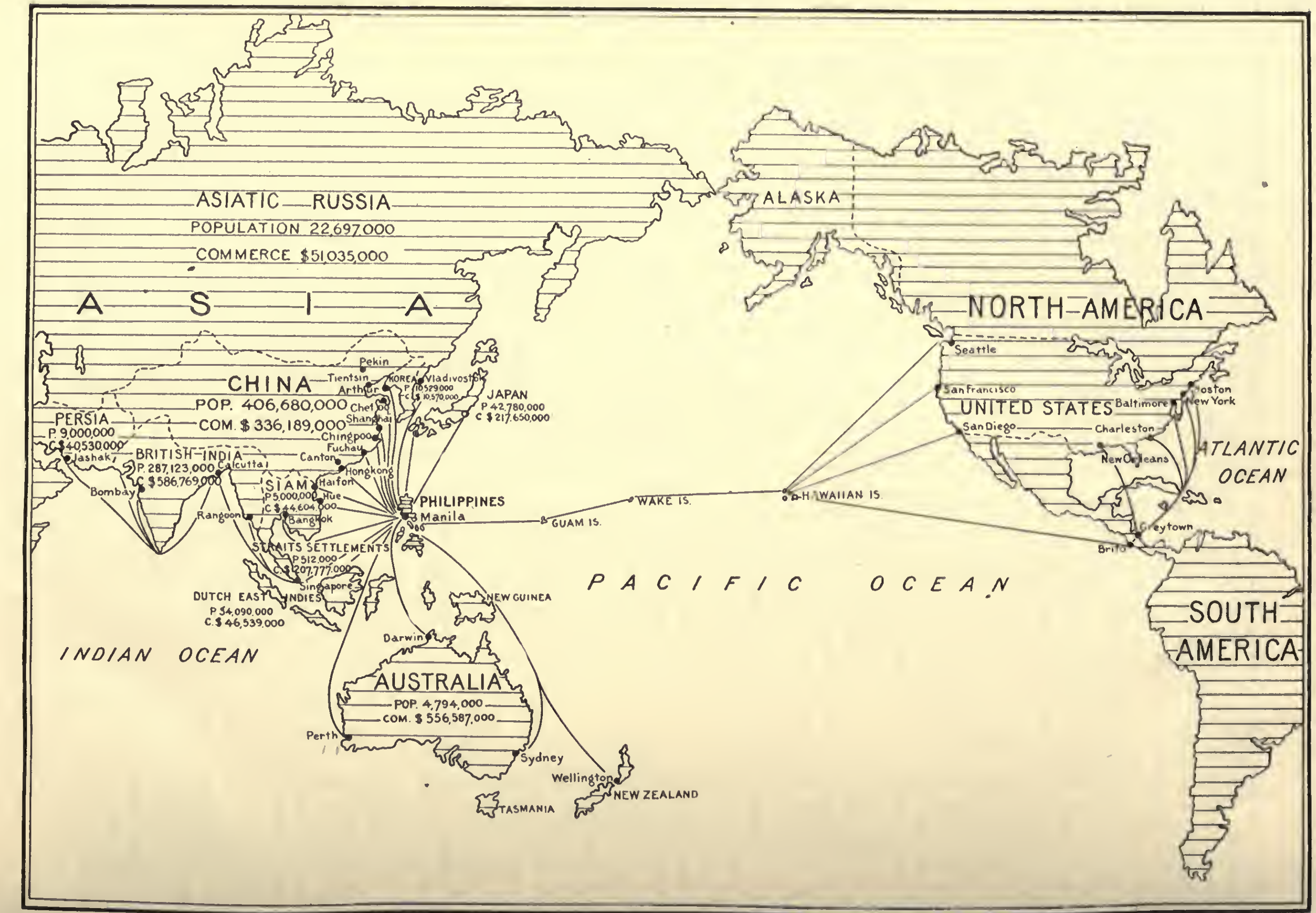
Map No. 4. Proposed Routes for Pacific Cables (see page 313)

supply, and receipt and delivery of messages, and in some cases the transshipment of cargoes, they are of great importance to commerce, while from the strategic standpoint they are of incalculable value. That they are considered of great importance to the vessels now engaged in this commerce is shown by the fact that the lines of both steam and sailing vessels, crossing the ocean in every direction, converge at practically all of the islands located in the midst of this great ocean. The map showing these routes is prepared by the Hydrographic Office of the Navy Department, and may, therefore, be considered authoritative on this subject. It will be seen that there are, in the midst of this great ocean, a half dozen points distinctly marked by these converging routes for both steam and sailing vessels, and a closer examination will show that the United States owns practically all of these, and especially those which have harbors of importance. At Unalaska on the north, Midway Island, the Hawaiian group, Tutuila, in the Samoan group, and Guam, in the Ladrones, the American flag flies, as it also does at Manila, farther to the west; and it is generally conceded that Pearl Harbor, in the Hawaiian group, and that of Pango Pango, in the Samoan, are by far the best, if not the only valuable, harbors in all the mid-Pacific. Curiously, all of these are located upon the natural routes for vessels in direct commerce between the United States and the Orient, and their importance, both to commerce and for naval and strategic purposes, can scarcely be overestimated.

My next proposition is that we also possess the most important routes for submarine cables, those great and important aids to commerce. The Pacific Ocean is the only great body of water in the inhabited portions of the globe which the ingenuity of man has not already bridged for the instantaneous transmission of thought. Within the remembrance of the present generation the Atlantic, the Mediterranean, the Indian Ocean, and the Gulf of Mexico have been crossed and recrossed with cable lines by which man speaks with man across thousands of miles of water, while the borders of the great continents in every part of the world have been festooned with loops of cable which connect their coast cities one with another and with the commercial centers of every part of the world. But up to this time the task of stretching a cable across the great Pacific, with its 10,000 miles of continuous water, has not been undertaken.

The Atlantic is crossed by a dozen lines connecting the United States with England and the continent of Europe; numerous lines are laid across the Mediterranean; several also extend through parts of the Indian Ocean, along the eastern coast of Asia and across to Australia, and shorter loops stretch from city to city along the coasts of Asia, Africa, and North and South America, but the great Pacific is an entire blank in the matter of intercontinental lines. Messages from the United States to the Orient at present go via Europe, through the Indian Ocean, skirting the eastern coast of the Asiatic continent, traveling enormous distances, handled several times, and occupying considerable time in transmission, to say nothing of the high rates of toll which must be paid for this circuitous service.

The experience of cable builders and operators is that a distance of 3,500 miles is about the limit at which cables can be satisfactorily operated without way stations, at which the messages are transmitted from section to section of the line. It is because of this fact and because there are few places in the Pacific in which islands are so located as to furnish the necessary way stations for relays that the construction of submarine telegraphs across that ocean has not been undertaken. Even where islands exist at such intervals as to justify the attempt, they were so divided in national control that no country or group of capitalists cared to undertake this enormous task. But now all this is changed. The events of the past three years have brought under the control of the United States a line of islands stretching at convenient intervals from the western coast of America to the eastern coast of Asia. The Hawaiian Islands, Wake Island, Guam, and the Philippines form a continuous line of great natural telegraph poles upon



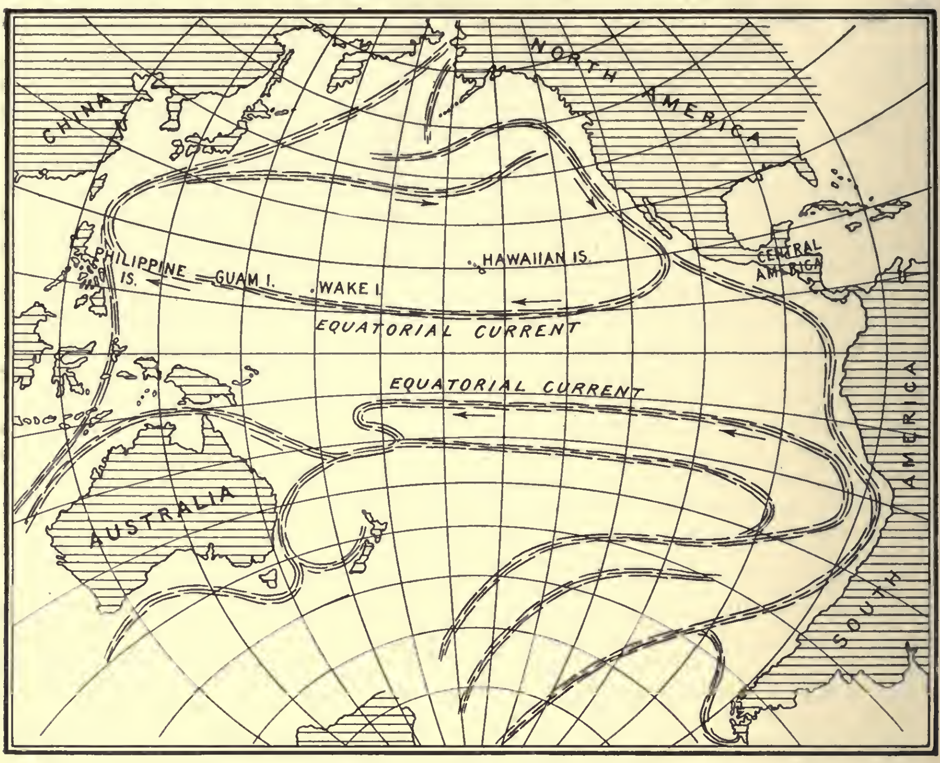
Map No. 5. Manila as a Distributing Point for Commerce (see page 315) which we may string a wire or series of wires, by which we may converse across this great body of water, stretching half way round the globe, making every one of its intermediate landings and relay stations on our own territory and protected by the American flag.

Meantime England has decided to attempt to connect the western coast of Canada, *via* Fanning Island, the Fiji group, and Norfolk Island, with her Southern Pacific possessions of Australia and New Zealand, The proposed routes of these two cable systems are shown on the map here presented.

It is proposed to also construct connecting links between Fanning Island and the Hawaiian Islands, and by a short side line connect the Samoan group with the main line. This would give to the American and the British lines an opportunity for an interchange of business and put all the important groups of the Pacific—the Hawaiian group, the Samoan Islands, the Fiji group, Guam, and the Philippines—in direct cable communication with our western coast, and enable vessel owners and owners of their cargoes to communicate with them en route to and from this great market which we are seeking to invade.

My next suggestion is that we have in the city of Manila a most valuable distributing point for commerce destined for the Orient. Located at a point where the steamship and sailing lines of the western Pacific converge, it becomes at once an important port of call, transshipment, and exchange, and lying midway between the great business centers of the Orient—Yokohama, Shanghai, Canton, Singapore, Calcutta, the Dutch East Indies, and the cities of Australia—it furnishes a base for commercial operations, a point where American warehouses filled with American goods will be accessible by cable and quick steamer transportation for all these points now so far removed from great European and American trade centers. That these natural distributing points are of great strategic importance to the commerce of the nation controlling them is illustrated in the growth of the commerce of the United Kingdom in the Orient since the establishment of Hongkong and Singapore as distributing stations for her commerce. Hongkong became a British colony in 1842, and Singapore at a somewhat earlier date. In 1840 the exports of the United Kingdom to the countries adjacent to these commercial stations amounted to but about $10,000,000, while today it is $125,000,000. While it is not assumed that this increase is entirely due to the control of these commercially strategic points by the United Kingdom, their great importance for such purposes is generally admitted. That our control of Manila is likely to be not only beneficial to American commerce, but even to establish us as a formidable rival in the trade of the East, is admitted by that distinguished British writer, Archibald R. Colquhoun, whose familiarity with conditions in the Orient makes him a recognized authority upon these topics. In his work entitled "The Mastery of the Pacific," recently issued, he says:

"The presence of America in the Philippines and the consequent shifting of the center of activity considerably to the east of Hongkong open a grave possibility, for it is obvious that Hongkong will in the future be out of the direct trade routes between Australasia, the Malay Archipelago, and the great markets of America. . . . The possibility of Manila becoming a serious rival does not at present seriously exercise the Hongkong merchant or ship owner, but . . . there are evident signs that the United States mean to make an important center of the capital of the Philippines. . . . Among the most significant factors of the Pacific situation is the advent of Russia coming *over-*



Map No. 6. The Air and Water Currents of the Pacific (see page 317)

land to the Pacific littoral, . . . and, on the other hand, the sudden appearance of the United States coming oversea and establishing herself in a large, populous, and important archipelago on the borders of Asia." In closing this discussion Mr Colquhoun adds these significant words: "The United States, in the opinion of the writer, will be the dominant factor in the mastery of the Pacific. She has all the advantages, qualifications, and some of the ambitions necessary for the rôle, and her unrivaled resources and fast-increasing population provide the material for future greatness."

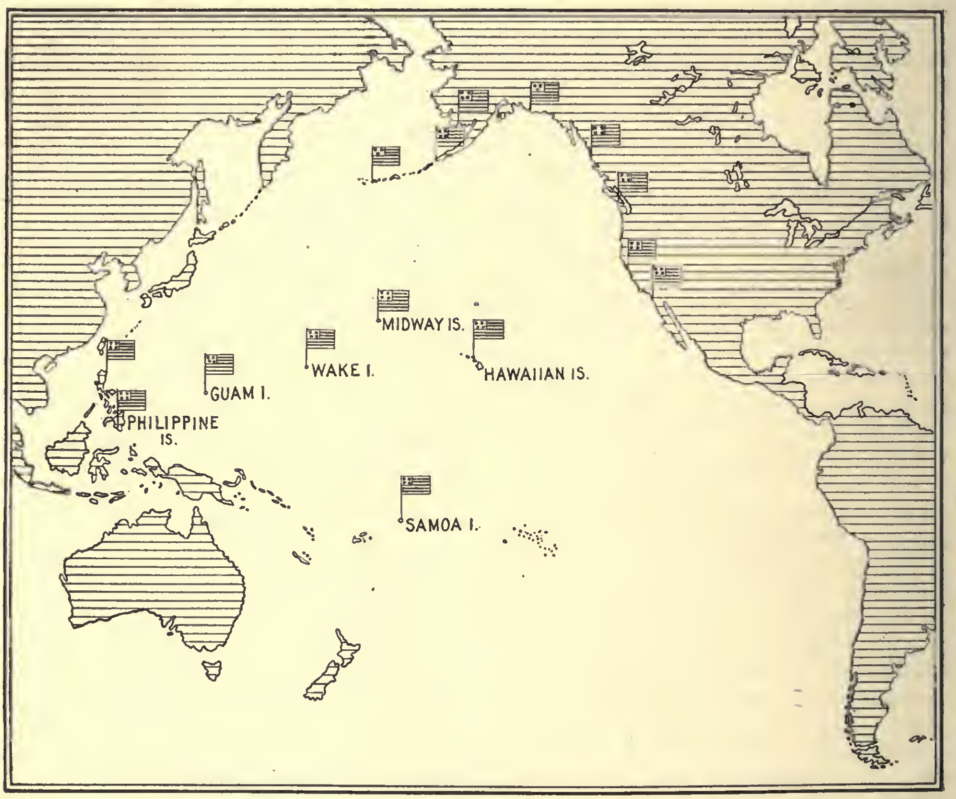
These words from this high authority, a representative of the present chief factor in the trade of the Orient, are significant, and they become more so when considered in conjunction with a map which I now present, illustrating the position of Manila as a distributing point for the commerce of that great semicircle of countries stretching from Bering Strait to Australasia, containing half the population of the earth and importing a hundred million dollars' worth of merchandise every month of the year.

I come now to my final proposition—that in certain great natural conditions, conditions which are as unchangeable as the oceans and the continents and the revolution of the earth itself, nature has given to the United States marked advantages regarding the movements of vessels between her western shores and the eastern coast of Asia, where the trade of the Orient must always center, and in this belief I find myself fully supported by the practical opinion and experience of distinguished officers of the American and British navies whom I have consulted and by men who have had long experience in the commerce of that great ocean. These advantages to which I allude are found in the great and permanent currents of air and water which flow westwardly across the Pacific in the vicinity of the Equator, turning northwardly along the coast of Asia, and, following the Japan coast, again move toward the east across the north Pacific and down the western coast of North America to the point of beginning. In the map herewith presented are shown the ocean currents and the currents of air, the direction of the movement in each case being shown by arrows. It will be seen that the equatorial current begins its westward movement at the very point in which vessels from an isthmian canal would enter the Pacific, and moves steadily westward to the vicinity of the Philippines, then, turning northward along the east coast of China and Japan, is deflected to the east, flows eastwardly across the north Pacific to the American coast, and then moves down the western coast of the United States to the point of beginning. The air currents, while their exact location is somewhat affected by the changes of the seasons, follow practically the same lines and are equally certain and reliable. The rate of speed at which this ocean current flows in its great circular movement across the Pacific and returns is probably on an average about one mile per hour, or 24 miles per day, while the rate of the movement of the air currents is of course much more rapid. While there is a general belief that vessels propelled by steam are little affected by favorable or adverse winds, a series of experiments recently made by German navigators and scientists shows that even with high-power steam vessels of modern type a difference of from 50 to 100 miles per day is realized in traveling with or against winds of any considerable power.

These facts, it seems to me, justify me in the assertion which I have made and now repeat, that this steady, permanent flow of air and water—a flow which will never cease so long as the earth revolves toward the east and the great bodies of land and water retain their present relative positions—must always give to the North American continent a marked advantage in the commerce of the Pacific. Its vessels from the eastern coast, entering this great whirlpool of the Pacific at the Isthmus, will move westward, aided by air and water currents, past our Hawaiian Islands, Wake Island, and Guam to the Philippines; thence northward to those two great trade centers, Shanghai and Yokohama, and thence, still following these currents, will move to the east along that shortest route known as the "great circle," in the north Pacific, touch at our own western ports for transshipment of fast freights for the East, and then, still following the ocean current down our Pacific coast, will reach the entrance to the Isthmian canal, having been aided by favorable currents of air and water in the entire circular tour of 18,000 miles. The entire feasibility of this plan is found in the fact that, while the actual sailing distance from the western end of the proposed Nicaraguan canal to Manila *via* Hawaii and Guam is 9,000 miles, the return trip from Manila *via* Shanghai, Yokohama, and San Francisco to Brito is but 9,500 miles, with the advantages of favorable wind and current in practically every mile of the entire distance.

I close, then, by the assertion that at least one of the great problems of the Pacific, that of commerce, has been solved, and solved in favor of the United

States. In the exchange of mutually necessary commodities, in length of frontage upon the ocean, in harbors, in way stations for vessels and cables, in advantageous points for distribution and concentration of trade, and even in the currents of air and water which nature has given, the conditions favor the United States. Indeed, when we consider all these things, we might almost claim the Pacific as essentially our own. Stretching along its eastern coast from the tropics to the Arctic, thence across its northern borders, then for more than a thousand miles on its western shore, in the Samoan group on the south, and in a line of islands across its very center, the American flag floats, and will continue to float, and by its presence, its ennobling purposes, and its power for civilization and advancement it proclaims, and will continue to proclaim, that the Pacific is, and will remain, an American ocean.



Map No. 7. "The Pacific is, and will remain, an American Ocean"

SHORTENING TIME ACROSS THE CONTINENT

By Henry Herbert McClure

TWENTY hours to Chicago, forty-five hours to Denver, ninety hours to the Pacific coast—these are the new records for long-distance transportation, taking New York city as the starting point, which indicate a general movement on the part of the great railroad systems of the country to save time across the continent and to draw closer together the important cities along the way. The establishment of the twenty-hour trains between New York and Chicago on June 15th may be said to mark the new era of transportation. Interest in that initial event had not subsided before there began a service out of Chicago which landed passengers in Denver in twenty-five hours, and plans are now being made whereby the transcontinental systems will run trains from Chicago to Los Angeles in something less than three days' time.

The movement is significant of genuine twentieth-century progress, and the new conditions may in a sense be said to have come about because of the need for improved facilities. It was well that the railroads should keep pace with the rapid movements of modern life just as formerly they were pathfinders and pace-makers for civilization itself. These United States owe much to the railroad systems, which have ribbed it with bands of steel and changed it from a tremendous territory which required months to cross into a community of farms, factories, towns, and cities.

The accomplishment of these new records and their maintenance as a regular daily occurrence places this country in the fore rank so far as railway facilities and fast long-distance speed are concerned. It is true that the Sud Express on the Orleans and Midi Railroad, running from Paris to Bayonne, makes an average of five miles per hour more than the Twentieth Century Limited of the New York Central, but the French train travels only half as far as the American. As a matter of fact, however, few trains in the world cover such long distances as those in this country, and comparisons are scarcely just. For example, the Siberian Express, running between Moscow and Irkutsk, makes 3,400 miles in eight days, an average of about one-third the speed of our trains. No one would regard this record as representing the best that Russian trains could do over distances of from 500 to 1,000 miles.

When the twenty-hour trains between New York and Chicago were first put on, they were designed to carry passengers and a limited amount of baggage only. The trains were made up of four cars—a buffet smoking and library car, two twelve-section drawing-room state-room cars, and one state-room observation car. On certain sections of the lines a dining car was added to each train. Within a few days, however, the government arranged for the addition of one mail car to each of these twenty-hour trains, and, as a result, this fast service has come to be of great value to thousands who might never wish to travel in the trains themselves. The new era of transportation at once inspires an interest, which is not merely wonder at its achievements—it becomes a practical, tangible thing, which calls for our appreciation because each one may be benefited by its existence.

The business man of New York city

is now able to mail a letter to his agent in Chicago on Monday and receive his reply on Wednesday morning. A tremendous advantage of the new train service is that, since the mails at New York close now six hours later, a whole business day is gained at St. Louis and points further west; almost a whole business day is gained for Pittsburg, Cincinnati, and Indianapolis. The mails for the new fast trains close at one o'clock in the afternoon at New York. Within an hour on one line, and two hours on the other, these pouches of letters for the west are whirling toward their destination. Columbus gains nearly ten hours by the new service; Cincinnati, seven hours; Indianapolis, eleven hours; Kansas City, eleven hours. In nearly all of the country southwest of St. Louis there is a gain of from ten to twenty-four hours. At St. Louis the gain is twenty hours outside of the business district, and twelve hours inside. Indeed, almost every section of the country has been affected by the new mail schedule made possible by these fast trains. The east-bound mails, of course, make practically the same gain in time. There are minor differences owing to connections at various points. The apparent discrepancies between the gain for business sctions of a city and the gain outside is explained by time of arrival being after business hours.

An amusing feature of the interest taken in these fast trains is the impressions made on those who imagine the trains rocking madly back and forth, taking the curves on two wheels and righting themselves with difficulty, and dashing by the scenery with such swiftness that nothing is to be seen save a blur of green from the fields.

"Guess you had to hold on to the seat some," was one comment.

It is a curious fact, but he who travels on one of these twentieth-century trains can scarcely appreciate more than the results. It does not seem to him that the train is moving swifter than an ordinary passenger train; but when he arrives at his destination, a thousand miles away, eight hours sooner than has been his custom, then he realizes that something unusual has happened en route. He has the feeling that the trip has been exceedingly comfortable, and he may have noticed that his train has made few stops—very short ones; that the engines were changed quickly, and that no time was wasted in getting under way again.

It was the writer's privilege to make the first trip of the Twentieth Century Limited over the New York Central and the Lake Shore Railroads. Aside from one instance, when the train had been delayed by a freight and there were fourteen minutes to be made up within an hour, which was done, it was not possible to distinguish a high rate of speed. An old railroad man was asked where it was that these trains gained eight hours on the average trains running between New York and Chicago.

"Suppose two men started out to run a mile race," he replied. "If one of them had to stop every hundred yards and the other ran right on, which one do you think would win?"

Fewer stops, then, have contributed to the saving of time, but other elements have entered into the matter. During the past five years millions of dollars have been spent in improving track and rolling stock, in shortening distances, and in reducing grades. There is now complete from Boston to Omaha a double-track line of railways. Every mile of this is guarded from wreck by the block signals. Many trains a day travel over the lines with absolute safety. The engines are heavier than formerly. Their capacity for coal and water is greater, and hence longer runs can be made without stops. Where division points were formerly 150 miles apart they are now separated by more than 200 miles. These are a few of the qualifications for speed.

Indeed, if one desired to account for all of the elements which combine in the result of present-day speed and comfort in long-distance travel it would be necessary to review the whole history of railroading. It is a far cry even from the service of twenty-five years ago to that of today. It is not so long since parlor and sleeping cars were unknown ; twenty-five miles an hour was considered a good speed for a passenger train ; there were no air brakes, no safety devices. Travel, even for five hundred miles, required considerable physical endurance. Now, however, New York to San Francisco is an easier journey than New York to Chicago was formerly. Electrically lighted trains, with library, buffet, dining, sleeping, and observation cars drawn by huge greyhounds of steel, whirl swiftly and safely over a pathway whose every mile is a monument in stone and steel to the engineering ability of our country. The traveler has every comfort at hand—a telephone is at his elbow, a bath-room and a barber shop are at his disposal.

Through the West, at least, as great changes have taken place in the country. In thirty years time the granary of the world has been opened up. Unbroken wastes have given place to thousands of prosperous towns. Maps were made and remade, and a geographical text book was not long in getting out of date. The growth of the West, as well as the development of the East, was not only fostered by the great railroads, but it was met and anticipated by them. Witness the rapid introduction of every modern invention which may be applied to railroading. On the Chicago and Northwestern and the Illinois Central Railroads passengers may telephone from the moving train to any point within the range of long-distance telephony. On a Texas railway wireless telegraphy is now being installed for the purpose of preventing collisions. The new twenty-hour trains between New York and Chicago are lighted with electricity generated by dynamoes attached to the car axles. These are mere details which indicate the struggle for the best service possible.

The New York Central's "Twentieth Century Train" stands first in point of speed, ease of operation, etc., between New York and Chicago. Their mileage is nearly seventy miles greater than that over which the Pennsylvania Special goes, but they have fewer grades and curves. Beyond Chicago the traveler will find four routes to the coast open to him. The Burlington No. 1 has recently increased its speed to Denver so that one hour and ten minutes are saved. Over the Rock Island's El Paso Short Line route will begin a service this fall by which the time to Los Angeles will be considerably shortened. The line to El Paso, completed only this year, is over 200 miles shorter from Kansas City than any other route, but the entire distance from Chicago to Los Angeles on the Rock Island and Southern Pacific is practically the same as that over the Santa Fé route. The former, by reason of a smaller per cent of grades, will be able to make more speed, while the latter will, of course, continue to hold its attraction as a scenic route through the mountains. The Chicago and Northwestern road has recently completed a two-track system to the Missouri River at Omaha—a movement which is part of a plan to make the facilities for travel as good as possible over this and the Union Pacific line to San Francisco. Within a year Salt Lake will be bridged. Millions of dollars are being spent in shortening distances, abolishing grades and curves wherever possible. Our country is becoming smaller all the time, and all because the transcontinental links of steel railways are annihilating space and conquering time with more vigor and result than ever before.

FIELDWORK OF THE UNITED STATES GEOLOGICAL SURVEY FOR THE SEASON 1902

THE following assignments of geologic and paleontologic parties of the United States Geological Survey have been made for the present field season:

Pacific Coast.—Dr J. C. Branner will continue areal surveys on the Santa Cruz quadrangle, California.

Mr J. S. Diller will complete the areal and economic survey of the Redding quadrangle, California, and make a reconnoissance of the Klamath Mountains. He will be assisted by Dr Geo. B. Richardson.

Dr Geo. F. Becker will continue the supervision of the Division of Physical and Chemical Research and the preparation of a report embodying his investigations on the conditions of gold deposition in the Mother Lode of California.

Dr T. W. Stanton will continue a general supervision of the paleontologic work of the Survey, and will carry on fieldwork in coöperation with Mr J. S. Diller in the Klamath Mountains of California.

Mr Geo. H. Eldridge, who has recently completed a study of the oil-fields of California, will devote the coming year to the preparation of a report on this subject and on the phosphate deposits of Florida.

Dr Geo. Otis Smith will continue areal surveys necessary for the preparation of the Snoqualmie folio, Washington. On the completion of his field season in the Cascade Mountains he will survey the Bluehill quadrangle, Maine. He will be assisted by Mr Frank C. Calkins.

Rocky Mountain Region.—Mr J. M. Boutwell and Dr J. D. Irving will study the mining geology of the Park City district, Utah.

Prof. T. C. Chamberlin will continue the supervision of investigations in Pleistocene geology of the United States. He will be assisted by Prof. R. D. Salisbury and Mr W. W. Atwood in the Rocky Mountain region, by Mr Frank Leverett and Mr F. W. Taylor in Michigan, and by Mr W. C. Alden in Wisconsin.

Mr S. F. Emmons will continue the supervision of investigations in the Division of Metalliferous Minerals, visiting various mining regions in the west for the purpose of examining work in progress and preparing plans for future work. He will be assisted by Dr J. D. Irving in the completion of work on the Leadville mining district.

Dr N. M. Fenneman will continue the investigation of the Boulder oil field, Colorado.

Mr Arnold Hague will continue the preparation of his monograph on the Yellowstone National Park, and will visit the park for the purpose of obtaining necessary additional information.

Dr T. A. Jaggar will complete the areal work necessary for the preparation of the Boston folio, and will prepare a report on the Bradshaw district, Arizona. He will be assisted by Dr Chas. Palache and Mr Laurence La Forge.

Prof. Wilbur C. Knight will continue the areal and economic surveys necessary for the completion of the Laramie folio, Wyoming.

Dr F. H. Knowlton will devote the year to the completion of reports on the fossil floras of the Puget and Laramie formations.

Mr Waldemar Lindgren has recently returned from a winter field season in Arizona, and will spend the greater part of the coming year in the preparation of reports.

Prof. H. F. Osborn will continue his investigations on vertebrate paleontology, and under his supervision special examinations will be made of the stratigraphy of the Colorado Jurassic by Mr F. B. Loomis, and of the Bridger, Washakie, and Uinta basins, Wyoming, by Mr W. B. Matthew and Mr Walter Granger, for the purpose of determining the exact stratigraphic position of beds from which fossil collections have heretofore been made.

Dr F. L. Ransome is at present engaged in the preparation of his report on the Globe, Arizona, mining district. Later in the season he will carry on areal and economic surveys for the preparation of the Bisbee folio, Arizona, and for a report on the Bisbee mining district. Dr J. Morgan Clements will be associated with him in this work.

Dr A. C. Spencer will study the areal and economic geology of the Grand Encampment mining district, Wyoming. He will be assisted by Prof. J. Volney Lewis.

Mr W. H. Weed will revisit Montana for the purpose of securing additional information required for the completion of his report on the Butte mining district.

Mr Bailey Willis will continue the supervision of the investigations in areal and stratigraphic geology. He will visit field parties in various parts of the United States, and will investigate the stratigraphy along the eastern base of the Rocky Mountains in Montana and Wyoming.

The Southwest.—Dr George I. Adams will make an areal and economic survey of the Yellville quadrangle in Arkansas, with special reference to the preparation of a report on the Arkansas lead and zinc district. He will be assisted by Prof. A. H. Purdue and Mr Ernest F. Burchard.

Dr Geo. H. Girty will investigate the paleontology and stratigraphy in connection with the work of various geologists in Arkansas, Indian Territory, Texas, and elsewhere.

Mr R. T. Hill will continue his investigation of the economic geology, stratigraphy, physiography, and vulcanism in the Trans-Pecos region of Texas, New Mexico, and Arizona. Dr Girty will be associated with him in this work.

Mr J. A. Taff will continue his areal and economic surveys in Indian Territory. He will be assisted by Prof. S. W. Beyer and Mr J. W. Beede.

The Northwest.—Mr N. H. Darton will continue areal surveys in the Black Hills and the Big Horn Mountains, and will complete a reconnoissance of the Great Plains for the preparation of a map showing the geology and water resources of that region. He will be assisted by Mr C. A. Fisher.

Northern and Eastern States.—Mr M. R. Campbell will continue the supervision of areal and economic work in New York, Pennsylvania, Ohio, Indiana, Kentucky, and West Virginia. He will be assisted by Messrs Charles Butts, Lester H. Woolsey, Ralph W. Stone, and Marcus Goldman in Pennsylvania, by Mr Myron L. Fuller in New York and Indiana, and by Profs. Geo. H. Ashley and L. C. Glenn in Kentucky.

Prof. T. Nelson Dale will continue his surveys in western Vermont, and will survey the Slatington quadrangle in eastern Pennsylvania. He will be assisted by Prof. Frederick B. Peck and Mr Fred H. Moffit.

Prof. B. K. Emerson will continue his investigations on areal and structural geology in Central Massachusetts.

Prof. J. F. Kemp will complete the fieldwork necessary for the preparation of the Mettawee folio in New York and Vermont.

Prof. Chas. S. Prosser will continue areal work necessary for the preparation of the Columbus folio, Ohio, and he will be assisted by Mr E. R. Cumings.

Mr Geo. W. Stose will continue in charge of the editing of geologic maps, and will spend a short field season in the continuation of work on the Chambersburg quadrangle, Pennsylvania.

Prof. C. R. Van Hise will continue the supervision of investigations on the pre-Cambrian and metamorphic rocks of the United States. He will visit various parties in the field for the purpose of verifying and coördinating work in his division. He will be assisted by Mr C. K. Leith in the preparation of a final monograph on the Lake Superior region, by Dr W. S. Bayley in the completion of fieldwork in the Menominee district, by Dr W. H. Hobbs in the continuation of surveys in Connecticut and Rhode Island, by Dr Florence Bascom in the continuation of areal and structural studies in the Philadelphia district.

Mr David White will continue his investigations on the paleobotany of the Carboniferous, working in coöperation with various geologists in West Virginia, Ohio, Pennsylvania, and Indian Territory.

Prof. Henry S. Williams will continue his studies on the co-relation problems of the Devonian in Pennsylvania, New York, and Maine. He will be assisted by Mr E. M. Kindle.

Prof. J. E. Wolff will continue the investigation of the areal and structural geology in the crystalline areas of New Jersey and southern Vermont.

Southern States.—Prof. W. B. Clark, with assistants, will continue the investigations of the geology of the Coastal Plain region in Maryland and Delaware, and of the Piedmont plateau of Maryland in coöperation with the Geological Survey of Maryland.

Dr William H. Dall will continue his studies for the completion of the revision of the Tertiary faunas of Florida.

Dr C. W. Hayes will continue the supervision of the investigations on nonmetalliferous economic deposits, and will continue areal work in the southern Appalachians. He will be assisted by Mr W. T. Griswold in the Eastern Ohio oil field and by Mr Edwin C. Eckel in Alabama and Georgia.

Mr Arthur Keith will continue areal, structural, and economic surveys in the southern Appalachians. He will be assisted by Mr H. S. Gale.

Dr W. S. Tangier Smith will be associated with Mr E. O. Ulrich during the early part of the season in the study of the lead, zinc, and fluorspar deposits of western Kentucky, and later will continue his investigation of the lead and zinc deposits of the Joplin district. He will be assisted by Dr C. E. Siebenthal.

Mr E. O. Ulrich will study the geology of the western Kentucky mining district in connection with Dr Tangier Smith's investigation of the mineral deposits. Later in the season Mr Ulrich will be associated with Dr Adams in Arkansas and Mr Taff in Indian Territory.

Mr T. Wayland Vaughn has recently returned from fieldwork in southern Louisiana, Alabama, Georgia, and Florida. He will be engaged throughout the greater part of the coming year in the preparation of a monograph on the fossil corals of the United States.

Alaska.—Four parties, under the supervision of Mr Alfred H. Brooks, are now carrying on geologic work in Alaska. The first, in charge of Mr Alfred H. Brooks, geologist, with Mr D. L. Raeburn as topographer, and five camp hands, is exploring the northern slopes of the Alaskan Range, having for its more especial aim a geologic and topographic reconnoissance of the region. This party expects to obtain important information concerning Mount McKinley, said to be the highest mountain on the continent, which lies in the heart of the Alaskan Range and whose base has not yet been reached. The party hopes to cross the Tanana River at the mouth of the Cantwell, and to investigate the Tanana and Birch Creek gold districts, reaching the Yukon at Circle City, thus obtaining a chance to examine the important and little known gold fields on the lower Tanana.

Mr Arthur J. Collier, geologist, accompanied by two men, will start at the international boundary and carefully study the coal deposits of the Yukon section as far as the delta, visiting also some of the placer camps accessible from the river, which have not yet been investigated.

The copper deposits of the Chitina River, a tributary of the Copper, have excited a great deal of interest among miners and capitalists. There have been many parties outfitted to prospect this region, and some preliminary development has been made. Prospecting has also been done in a second copper belt in the northern part of the Copper River and in the upper Tanana and White River basins. These two belts are to be the subject of special investigation during the coming season. The Chistochina gold fields, also included in the Copper River basin, have become important producers of placer gold. A survey of their entire area is contemplated. The surveys of the Copper River basin will also throw a good deal of light on the proposed railway route from Valdes to the Yukon River, and they will cover large areas which are believed to have value for stock-raising and for cultivation.

The work in this region has been divided. One party, in charge of Mr F. C. Schrader, geologist, with Mr D. C. Witherspoon, topographer, will map the Upper Copper River Basin and adjacent portions of the Tanana Basin, giving special attention to the upper northern belt; the other party, in charge of Mr T. C. Gerdine, topographer, with Mr Walter C. Mendenhall, geologist, will map the Chistochina gold fields and will give attention to the southern copper belt.

In addition, Mr W. J. Peters, topographer, will make a map of the Juneau mining district as a base for future detailed geologic studies. The Juneau district is the most important in all Alaska, containing, as it does, the famous Treadwell mine.

Hawaiian Islands. — Dr Whitman Cross will suspend his regular fieldwork in Colorado for the present season and will spend a portion of the year in the Hawaiian Islands, for the purpose of investigating volcanic phenomena.

Mr G. K. Gilbert does not expect to carry on any fieldwork, but will be engaged throughout the year in the preparation of reports.

Prof. Lester F. Ward will continue the preparation of reports on the Mesozoic floras of the United States.

FOREST RESERVES

Mr Henry Gannett, in charge of the examination of forest reserves, will examine forest reserves in Utah, and will visit the different parties working in the field under his direction.

Mr Arthur Dodwell will complete the examination of the San Francisco Mountain Reserve of Arizona, and will continue work to the southward and eastward in the Black Mesa Forest Reserve, Arizona, as far as the season will permit.

Mr Theodore F. Rixon will commence the examination of the Black Mesa Forest Reserve, Arizona, completing, with Mr Arthur Dodwell, the entire area of the reserve.

Mr Fred G. Plummer will examine the Uinta Reserve, in the northern part of Utah, a rather narrow, irregular strip of country, lying mainly along the top and north slopes of the Uinta Range.

TOPOGRAPHIC WORK OF THE U. S. GEOLOGICAL SURVEY IN 1902

IN WASHINGTON, OREGON, AND CALIFORNIA

WASHINGTON.—Topographic work will be commenced under the general direction of Mr Richard U. Goode, geographer, in two general localities in the State of Washington. Two parties will operate in the eastern part of the state and three parties in western Washington, in the forested regions of the Cascades.

One of the eastern parties will be under Mr L. C. Fletcher, with Messrs J. G. Hefty and J. B. Bond as assistants, and will outfit at Republic. The work will be an extension westward of that commenced during the past season in the vicinity of Republic, the area to be surveyed extending along the international boundary for about thirty miles and including the valley of the Okanogan River and the region adjacent to Osoyoos Lake.

The second eastern party will be under Mr George T. Hawkins, and will outfit at Spokane. The work assigned to this party is the extension of the existing triangulation in the vicinity of Spokane southward through Whitman, Garfield, and Asotin Counties. This triangulation will be followed as soon as may be practicable by a detailed topographic survey, and the resulting maps will in turn form a basis for the investigation of the important economic problems in this region. If practicable this triangulation will be connected during the present field season with that brought northward from the vicinity of the Baker City region by another party, thus making a connection between the astronomic positions determined at Spokane and Baker City.

The western sections will be covered by parties operating in three districts, that in the northwest district being under the charge of Mr R. A. Farmer. The party will outfit at Wenatchee. The area selected to be surveyed will be that known as the Stehekin quadrangle, in the Washington Forest Reserve, and will include the upper portion of Lake Chelan and a portion of the crest line of the Cascade range.

In this general locality will also be a party under Mr E. M. Fry, whose duties will be to determine by spirit-leveling elevations above sea-level of various points in the Cascade Mountains along the Skagitt and Nethow Rivers and in the mountains between Republic and the Colville River.

The party in the central district of the western section will be under the charge of Mr A. E. Murlin, and will survey the Skykomish quadrangle, which includes an area of about 800 square miles north and south of the Great Northern Railroad, in the vicinity of Skykomish, within which are many mines and much valuable timber. A portion of this quadrangle is within the Washington Forest Reserve. Mr Murlin will have for his principal assistants Messrs W. C. Guerin and C. W. Sutton.

Mr A. H. Sylvester will have charge of the third party in the western section, or that operating in the southern district, and will outfit at North Yakima, the work being a continuation of that done during the preceding field season upon the Mt. Aix quadrangle. The greater portion of this quadrangle is in the Mt. Rainier Forest Reserve. It includes a number of passes along the summit of the Cascades and the headwaters of the White and Cowlitz Rivers, flowing to the west, and of the American, Bumping, and Tieton Rivers, tributaries of the Natches and Yakima Rivers. Mr Sylvester's principal assistant will be Mr Ralph Cowgill.

All the work in the western section is a continuation of the systematic survey, begun several years ago, of the forested areas of the Cascade Mountains.

Oregon.— Topographic work under the direction of Mr Richard U. Goode, geographer, will be continued in Oregon in two localities—one in the eastern portion of the state, in the vicinity of Baker City, and the other west of the Cascades, in the vicinity of Riddles.

The party operating in eastern Oregon will be in charge of Mr C. F. Urquhart, his principal assistant being Mr R. B. Robertson, and will outfit at Baker City. The work will be an extension of the existing triangulation eastward and northward into Union and Wallowa Counties, the object being to provide starting points for future topographic work, which will extend through the forested areas and mining districts. The party will commence work about July 1, and remain in the field as long as the weather conditions are such that work can be prosecuted in the mountains.

In western Oregon one party will be under the charge of Mr A. B. Searle, and will commence operations in the vicinity of Glendale. The work will be in continuation of that commenced during the past field season, and will result in the completion of the Riddles quadrangle, comprising an area of about 900 square miles. This region is noted for its various mineral deposits, the examination and study of which by Mr J. H. Diller, geologist, will follow upon the completion of the topographic map.

Another party, under Mr C. H. Semper, will be engaged in carrying a line of primary levels from a tidal connection at Benicia, California, along the line of the Northern Pacific Railroad as far northward toward Portland as available funds will permit of. Iron benchmark posts, on which will be stamped the elevation above sea-level to the nearest foot, will be established at all prominent points and at intervals not exceeding three miles. These levels will furnish a main trunk line, from which other lines of levels will ultimately branch into the territory to the east and west of the state line, thus furnishing the vertical control for future topographic work

California.—Under the general direction of Mr Richard U. Goode, geographer, topographic work will be prosecuted in various localities in California during the coming field season. In the northern portion of the state a special map will be made of the Keswick mineral region, including an area of about 30 square miles. A portion of this area is included in the Redding quadrangle, which has been recently surveyed on the scale of about two miles to the inch. The special work will be on the scale of about one mile equal to three inches, the large scale being necessary to a proper study of the geologic questions involved in this important district. The party engaged in this work will be in charge of Mr A. B. Searle.

In the central portion of the state two parties will operate, the areas to be surveyed being within or adjacent to the Sierra Forest Reserve. One of the parties will be under the charge of Mr R. B. Marshall, who will have as his principal assistants Messrs George R. Davis and L. D. Ryus. The party will outfit at Fresno, and will complete the survey of the Kaiser Peak quadrangle commenced during the previous season, which includes the upper portion of the San Joaquin River. This party will also extend spirit levels so as to afford vertical control for future topographic work in the Mount Silliman and Kings River Canyon region.

The second party in central California will be in charge of Mr E. T. Perkins, who will have as his principal assistants Messrs A. I. Oliver and W. V. Hardy. This party will outfit at Visalia and will survey the Kaweah or Three Rivers quadrangle, an area of nearly 1,000 square miles, including the headwaters of the principal tributaries of the Tulare River.

In southern California there will be two parties. One of these parties, under Mr W. T. Turner, with Mr S. N. Stoner as his principal assistant, will continue the work which has been going on for several years in the Mount Pinos and Zaca Lake and Santa Ynez Forest Reserves.

The other party, under Mr J. E. Rockhold, with Mr E. R. Childs as his principal assistant, will complete the work begun during the past field season in the vicinity of San Diego, thus finishing the mapping of practically all of the thickly inhabited portion of southern California.

Precise spirit-leveling will be continued by a party under Mr C. H. Semper. This party will first complete a gap in the line which was begun during the last field season at a tidal connection at Benicia and carried through the San Joaquin Valley and across the Tehachapi Mountains, so as to make a junction with spirit levels previously run in southern California. After this work is completed the party will go north to the vicinity of Sacramento and commence another precise line which will have its ultimate termination at Portland, Oregon. In connection with this line iron bench-mark posts will be established along the line of the Southern Pacific Railroad at intervals of about three miles, on which will be stamped the elevation to the nearest foot above sea-level.

In the fall, after it becomes too late to work in the northern states or the high Sierra, two large parties will commence work along the Colorado River, one outfitting at Yuma and the other at Needles. This work is undertaken with a view of determining the practicability of utilizing the waters of the Colorado River, which at present are wasted into the ocean, for the purpose of irrigating the vast tracts of desert lands in California and Arizona adjacent to the river.

Later in the season it is also contemplated to do certain preliminary work looking eventually to the topographic mapping and geologic investigation of the Coalingua, Bakersfield, and McKittrick oil fields.

GEOGRAPHIC NOTES

NEW KEY TO THE REPORTS OF THE U. S. GEOLOGICAL SURVEY

THE U. S. Geological Survey has just issued, in Bulletin No. 177, a catalogue and index of its publications. This compilation has been made necessary by the increase in the number of the publications since the last catalogue was published in 1893 and by the need of a convenient classification.

The first part of the compilation is composed of notices of all the Survey's publications from its inception to date; the annual reports, monographs, bulletins, water supply, and irrigation papers, the volumes of the old series of mineral resources, geologic atlas folios, topographic atlas sheets, special maps, and miscellaneous publications.

The second portion of the volume is an index, alphabetically arranged, comprising 742 pages. It is a broad classification of the subject-matter of the publications, yet sufficiently detailed to be of value in economic, scientific, engineering, and educational lines.

DECISIONS OF THE U. S. BOARD ON GEOGRAPHIC NAMES

June 4 and 5, 1902

Barnett; run, near Bridgeport, Harrison County, West Virginia (not Barnet).

Bentons Ferry; post-office and railroad station, Marion County, West Virginia (not Benton Ferry).

Bonaire; island, one of the Dutch West India Islands, in the Caribbean Sea, off the coast of Venezuela (not Buen Ayre).

NOTE.—This is a reversal of the decision Buen Ayre, made in 1891.

Cobun; creek, in Monongahela County, West Virginia (not Coburns).

Connorville; post-office and railroad station, Jefferson County, Ohio (not Connor nor Connorsville).

Davisson; run, branch of West Fork River, Harrison County, West Virginia (not Davidson's).

Davisson; run, branch of Simpson Creek, Harrison County, West Virginia (not Davidsons).

Fassett; point, Sinepuxent Bay, Worcester County, Maryland (not Fassetts nor Henry).

Fudges; creek and post-office, Cabell County, West Virginia (not Fudger).

Gibson City; post-office and railroad station, Ford County, Illinois (not Gibson).

Glenns; run, Ohio County, West Virginia (not Glen's).

Glenns Run; railroad station, Ohio County, West Virginia (not Glens Run).

Green Village; post-office and railroad station, Franklin County, Pennsylvania (not Greenvillage).

Horrell; precinct, Frontier County, Nebraska (not Howell).

Hupa; Indian tribe, mountain, and post-office, Humboldt County, California (not Hoopa, Hoopah, Ho-pah, Hupâ, Húpô, Noh-tin-oah, nor Up-pa).

Hupa Valley; Indian agency and reservation, Humboldt County, California (not Hoopa Valley).

Inner Manchas; coral reef or bank on north side of entrance to Mayaguez Bay, Porto Rico, West Indies (not Inner Machos, etc.).

Jaffrey; point, the southern point of entrance to Portsmouth harbor, New Hampshire (not Jaffray nor Jerry's).

NOTE.—This is a reversal of the decision Jaffray, made March 7, 1900.

Kenneatto; creek, Fulton and Saratoga Counties, New York (not Fonda nor Kennyetto, etc.)

Lehi; post-office and railroad station, Utah County, Utah (not Lehi City).

Machos Grandes; coral reef or bank on south side of entrance to Mayaguez Bay, Porto Rico, West Indies (not Allart, Great Manchas, nor Machos).

Manchas; coral reef or bank on north side of entrance to Mayaguez Bay, Porto Rico, West Indies (not Machos Grandes).

Manchas Chicas; coral reef or bank on north side of entrance to Mayaguez Bay, Porto Rico, West Indies (not Machos Chicos).

Outer Manchas; coral reef or bank on northern side of entrance to Mayaguez Bay, Porto Rico, West Indies (not Outer Machos).

Pereleshin; mountain, east of the Stikine River and near the Alaska-Canada boundary line (not Pereleshini).

Provo; post-office and railroad station, Utah County, Utah (Not Provo City).

Raquette; lake, Hamilton County, New York (not Racket).

Raquette; pond, Franklin County, New York (not Racket).

Raquette; river, of northern New York, draining lake and pond of same name, and emptying into the St. Lawrence River (not Racket).

Raquette Lake; post-office and railroad station, Hamilton County, New York (not Racket Lake).

Sea Gull; six rocky islets between Unalga and Akutan, in Akutan Pass, eastern Aleutians, Alaska (not Baby nor Gull).

Southmayd; post-office and railroad station, Grayson County, Texas (not Southmayde).

Steel; mountain in the Olympic group, Jefferson County, Washington (not Steele nor Stone).

Valdes; glacier, narrows, port, summit, and town, Prince William Sound, Alaska (not Valdez).

Van Etten; post-office, railroad station, township, and village, Chemung County, New York (not Vanetten).

West Fork; river, in Marion, Harrison, and Lewis Counties, West Virginia (not West Fork Monongahela).

Wheeling; creek, Ohio and Marshall Counties, West Virginia (not Big Wheeling).

Wheeling; island in Ohio River at Wheeling, West Virginia (not Madison nor Zanes).

Willow Island; railroad station, Dawson County, Nebraska (not Willow).

COMMERCIAL ALASKA

THE title of a monograph just issued by the Treasury Bureau of Statistics is "Commercial Alaska in 1901." In it are presented some striking figures about this little-understood territory of the United States. A million dollars a month is the estimate made by the Bureau of Statistics of the present value of the market which "frozen Alaska" offers to the producers and manufacturers of the United States.

Gold, fish, and furs are, according to this monograph, the principal industries of Alaska at the present time, and they send to the United States 15 million dollars' worth of their products—8 millions of gold, 6 millions of fish, chiefly salmon, and the remainder furs.

The cost of Alaska was $7,200,000. The revenue which the government has derived from it since its purchase amounts to over 9 million dollars, and the value of the products are now twice as much every year as it cost. The total value of the products of Alaska brought to the United States since its purchase is (according to the best estimates that the Bureau of Statistics is able to make) about 150 millions. of which 50 millions are precious metals, 50 millions products of the fisheries, chiefly salmon, and 50 millions more furs, chiefly seal fur. Probably 50 million dollars of American capital are invested in Alaskan industries and business enterprises, including transportation systems. In the salmon fisheries alone the companies engaged have a capitalization of 22 million dollars, and the value of their plants, including vessels, is given at 12 million dollars. In the mining industries there are large investments, the great quartz mill at Juneau being the largest quartz stamp-mill in the world, while several other quartz mills represent large investments.

The Mazamas.—The annual outing of the Mazamas this summer is a trip to the summit of Mount Adams. The Mazamas are a society of mountain climbers and one of the most unique organizations in the United States. The qualification for membership is the ascent of some snow-capped peak formidable enough to make the ascent more than a pleasure trip. The society was organized in the summer of 1894, on the summit of Mount Hood. So much enthusiasm was felt at that time that 193 people climbed the 11,225 feet to the summit of Mount Hood in order to attend the first meeting. Each year the club makes successful expeditions up some mountain. Mounts Baker, Rainier, Adams, Hood, and Jefferson, as well as Crater Lake, on the summit of Mount Mazamas, have each been visited.

An expedition to take meridian measurements in the Arctics, north of Spitzbergen, left Tromsö late in July. The expedition was organized in Sweden, and is directed by Dr P. Rubin and includes Dr von Zeipal as astronomer and Lieu. Duner as cartographer.

GEOGRAPHIC LITERATURE

Mosaics from India. By Margaret B. Denning. Illustrated. New York: Fleming H. Revell Co.

The title of this book is well fitted to its contents. Each chapter is a story in itself. The customs of the people are set forth by graphic terms and illustrations. The author shows the opposition that has been brought against the missionaries by the superstitions of the people. Many new points of the inner side of the social conditions of the Hindoo family are depicted in a vivid manner. Chapters devoted to The Recent Famine, The Classes of Society, The Missions, etc., describe in an interesting and instructive manner the observations of a personal tour of the far regions of country by the missionary author.

Bird Life, a Guide to the Study of Our Common Birds. By Frank M. Chapman. 8vo, pp. xii + 195, with Appendix, with 75 colored plates and 25 text cuts. Third edition. New York: D. Appleton & Co. 1902.

The study of birds has become popular and, let us hope, not a fad or a craze, to run its course and disappear, but a permanent feature of the rising interest in science; for no more delightful interest can be added to life than the study of our feathered neighbors, making their personal acquaintance, familiarzing ourselves with their home life, their housekeeping methods, their loves, and their hates.

Mr Chapman has given the public one of the best of many volumes which have been called into being to minister to this interest. The first part is devoted to feathered creation in general—describing the bird's anatomy, colors, and change of color, migrations, songs, and nesting seasons. Popular descriptions of common species follow, and are illustrated with colored plates. Without depreciating the text in the least, the colored illustrations are the most valuable feature of the work. Well drawn and well reproduced, they alone aid the amateur more in identifying species than any amount of description could do. It would be better if the colored figures were placed in juxtaposition with the related text, instead of being widely separated from it.

The book closes with an appendix for the use of teachers. H. G.

Practical Forestry — For Beginners in Forestry, Agricultural Students, Woodland Owners, and others desiring a general knowledge of the nature of the art. By John Gifford. 8vo, pp. xiv + 284, with 35 illustrations. New York: D. Appleton & Co. 1902.

Part I opens with a collection of excellent definitions, and the succeeding chapters treat in turn of the relation of silviculture to the broad subject of agriculture, the forest canopy and floor and the wood mass, the geographic distribution of forests and their geographic effects. Part II is devoted to the formation and tending of forests, Part III to their industrial importance, the wood industries, etc., while the concluding part, after listing the forest reserves, describes the principal forest trees.

Among the numerous books on Forestry recently published, this will deservedly stand high. Where there is so much to praise, it seems almost captious to criticise. Certain of the methods of restoring forests here described—*i. e.*, to restore forests by replanting trees—is a method that will not be followed in this country on any considerable scale for centuries, however applicable it may be to the countries of Europe. The author confuses the plains and the prairies, and is still among the agnostics concerning the influence of forests on rainfall. H. G.

A Ride in Morocco Among Believers and Traders. By Frances Macnab. 8vo, pp. 367, with 10 illustrations and 1 map. New York: Longmans, Green & Co. 1902.

This is a narrative of a journey down the coast of Morocco to Mazaglan, and thence south to the city of Morocco (Marakesh), returning to the coast at Mogador. Miss Macnab is an experienced traveler and observer, and her journal and the accompanying observations on the country and people are graphic and of great interest. The utter rottenness of the government and the degradation of the people under its oppression are scarcely conceivable. It is a picture of the retrogression, for these are the Moors whose ancestors made the civilization of Spain.

Altitudes in the Dominion of Canada, with a relief map of North America. By James White, geographer, Department of the Interior. Ottawa, 1901.

This is the first comprehensive collection of elevations in Canada to be published, those of Messrs J. W. Spencer and Warren Upham, published by the U. S. Geological Survey, relating to portions only of the Dominion. The publication comprises abstracts of the profiles of the railways and canals, profiles of rivers, and many miscellaneous heights, including levels of the Great Lakes, arranged geographically. As to fullness and accuracy, the work leaves little to be desired. The arrangement, however, is not a convenient one, and should have been at least supplemented by a full index of names of places. The relief map, printed in tints, is a very valuable addition to our knowledge of the northern part of our continent.

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THE
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PROBLEMS OF THE PACIFIC—THE GREAT OCEAN IN WORLD GROWTH*

BY W J McGEE, LL.D.,

VICE-PRESIDENT NATIONAL GEOGRAPHIC SOCIETY

THE greatest by far among great geographic features is the Pacific basin. If all the continents and islands forming the face of the earth were joined in one great continent, its extent would scarce equal that of the great ocean; and if the mass of all the lands of the globe above sea-level were poured into the Pacific, barely more than an eighth of the basin would be filled. Three-fourths of our world-surface is water; a full third of this vast expanse, or a quarter of the superficies of the planet, is that of the great ocean, while its abysses are of such depth that a full half of the water of the earth is gathered into its basin. In every view the Pacific is vast, so vast as to tax if not to outpass our powers of contemplation.

Nor is it only in the magnitude of the basin that the Pacific is vast; its area is indeed unequaled and its abysses unparalleled in profundity and extent, yet the great world-scar becomes far more striking when regarded as a record of processes in planetary growth, and still more when viewed as a theater of that vital activity culminating in the growth of races and peoples and the development of high humanity. The basin is bounded on the east by a wrinkle in the terrestrial face which on closer view resolves itself into the longest and second highest mountain system of the world, whose rocks must hold our best record of earlier world-making; its other side, half a world-circuit away, is skirted by our greatest continent and several subcontinents, which must give the globe's best record of the later stages in world-building; while half its expanse is studded with islands which must tell eloquently of world-making whenever their mute testimony comes to full interpretation. Lesser chapters of world-growth may be read from the shorter records of smaller provinces; longer chapters are read from the fuller records of larger provinces, such as those of our own well-studied continent; but it cannot be doubted that the fullest record of all will be found in the foremost of geographic features, to form the body of the book of world-history. If, as biology and paleontology seem to teach, the earliest living things on the globe were aquatic if not marine, it would seem probable that the life of the world began somewhere about the present Pacific, and spread thence over the growing continents eastward and westward, as well as northward and southward until the eternal barriers of arctic and antarctic ice were built out from the poles of the cooling planet. Hazy as the vital vista may be in its remoter stages, there is nothing questionable about the leading role of the Pacific as a factor in the later life of the globe; the horse, as shown by Marsh, and the dog, as held by Osborn, are among the animals that came up on the eastern purlieus of the Pacific, to be somehow translated to the western border-land during later geologic times; the paths of several migratory birds still cross the narrow northerly portion of the Pacific in such wise as to bind hemispheres into a single faunal province and prove that the avian instinct outlasts continental outlines; while Cook contends that the palm, and perhaps the banană and other plants, must have been carried across the Pacific from east to west by human agency after prehistoric man reached the plane of primitive husbandry. Still less is there question as to primacy of the role played by the Pacific in human development. Counting in the basin the lands draining toward its depths, the Pacific province is the home of half the population of the earth; the abiding-place—if not the birthplace—of the black, yellow, brown, and red races of mankind, and now the realm of the white; the seat of societies ranging from the lowly clanship of the prime to the most resplendent empires of history; the field of cultures rising from bestial savagery to the world's highest enlightenment.

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*A lecture before the National Geographic Society, April 9, 1902. The summary and final lecture of the Afternoon Course of the season 1901–1902 on the general subject, "Problems of the Pacific." The course comprised also "Japan," by Prof. Ernest F. Fenollosa, March 12; "Australia and New Zealand," by Henry Demarest Lloyd, March 19 (published in this number); "The Lesser Islands," by Dr. C. H. Townsend, March 25; and "The Commerce of the Great Ocean," by Hon. O. P. Austin, April 2 (published in this volume, pp. 303–318).

Such are some of the aspects of the earth's greatest feature, of that boundless theater of life and human activity on which the eyes of the world are turned today.

THE GENESIS OF THE OCEAN

Foremost among the greater problems of the Pacific is that connected with the origin of the basin in which the great ocean is cradled; and this problem can hardly be approached save along the lines of world-growth suggested by the relation of our sun and other stars, our earth with the rest of the planets, and our moon with the other satellites of the solar family—for the problem of the Pacific basin is large enough to be viewed as a cosmic problem. Since the days of Laplace, author of the nebular hypothesis, the attention of astronomers has been attracted by the great world-chasm, and several students have conceived it as the scar left by the off-casting of the moon during an early stage in the condensation of the earth from a primordial chaos of matter. The latest noteworthy discussion of these views of the Pacific is that of G. H. Darwin, son of the naturalist, and our leading authority on tides. "According to his luminous theory the tidal action of the sun on the viscous earth formed two protuberances at opposite points of the equator; one of the protuberances broke away and solidified as the moon, which revolved around the earth much nearer than at present." So Gregory summarizes the conclusions of the eminent mathematician (Smithsonian Report, 1898, p. 366). Another view of the great basin connects it with the general warpings and the flexures or fractures of the earth-crust marked by other large geographic features, all supposed to grow out of a tendency of the terrestrial ball to approach the form of a tetrahedron with the slow shrinkage due to secular cooling. This theory of a "tetrahedral earth" is far too elaborate and many-sided for summary in a sentence; it must suffice to note that it was framed by Lowthian Green during a long residence on one of the islands in the great ocean and under the inspiration of its grandeur, that such geologists as Gregory in England, and Emerson and Hitchcock in this country, have viewed it with favor, and that our fellow-citizen, Preston (of the Coast and Geodetic Survey), thinks "Nothing is more in accordance with the action of physical laws than that the earth is contracting in approximately a tetrahedral form" (*ibid.*, p. 377). It is just to say that certain other geologists and physicists are less attracted by the enticing view outlined by Lowthian Green; they hold that the hypothesis requires greater rigidity in the earth-crust than that attested by various well-known facts of geology. So, too, the view that the Pacific basin is a moon-scar is rejected by some thinkers; for example, our associate, Gilbert, would have it that our luminary of the night was probably formed more largely by accretion of cosmic matter than by robbing our planet of so much of her substance. Yet, whether the views—either or both—be accepted or rejected, they are well worth weighing; they are products of great minds, and must stimulate our powers of contemplation and emphasize the magnitude of our greatest geographic feature.

If a trace of personal conviction may be infused in the discussion of so broad a field, it may be questioned, first, whether either the astronomical or the physical hypothesis is necessary, in view of the great fact that the Pacific basin is precisely like the other oceanic basins in kind, differing only in degree of magnitude; and, second, whether the legion islands of the sea stretching from Hawaii and Easter Island to the borders of the Asian and Australian continents do not prove that this greater part, at least, of the vast basin is but a drownéd land whose higher peaks and volcanic vents still rise above sea as monuments to its former greatness. Certainly there are many points of similarity between our own Antillean and Bahamian outliers and the seemingly boundless archipelago stretching a third of the way round the globe from Asia and Australia; certainly, too, the unavoidable inference that our lesser archipelago is a series of culminating points of an ancient land gives warrant for a parallel inference with respect to the insular peaks projecting above the waters of the Pacific; and certainly, again, the geologist's necessity for a Paleozoic Atlantis as a source of the five-mile-thick formations of the Appalachian zone must be shared by those delvers in the rocks seeking the source of the vaster sediments lying between the Himalayan crests and the littorals of the Pacific. It is not to be forgotten that whether the low mountain be old or young, the high mountain is always a young mountain; nor is it to be forgotten that the volcano and the earthquake are symptoms of general geologic activity with attendant geographic changes. So the bleak heights of Thibet and the steep footslopes below, which feed the mighty Hoangho and the Yangtse so fully that they in turn color the Yellow Sea with their silts; so, too, the recurrent earthquakes of Japan and neighboring islands; so also the island volcanoes, led by Krakatoa, whose last outbreak shook half the earth and blew dust-clouds to the remotest lands—all these and many other stupendous phenomena are among the indications that the internal forces and agencies of earth-making culminate somewhere about the great archipelago of the farther Pacific. And the magnitude of the internal force attested by these outward manifestations is ample to account for even so great changes in the earth-crust as those involved in likening the broad Oceanian archipelago with our own Bahamas. Other reasons for viewing Oceania as a mountain-set land drowned by subsidence during a later geologic age might be drawn from the laws of continental growth; but these may be passed over.

Accordingly, the problem of the genesis of the Pacific must be left open pending research in many lands and along many lines; yet for the present it would seem safer to regard this greatest of geographic features as the product of proper earth-movements and consequent geographic changes rather than a direct heritage of cosmic interaction—the birth of the basin may better be viewed as of the earth earthy than of the stars starry and remote.

THE PACIFIC AS A VITAL PROVINCE

During most of the time since earth began the great ocean was, like other provinces, mindless, scriptless desert; and it remains in exceptional degree barren because of the poverty of its paleontologic record—for the fossil record is one of fecund shorelands and fruitful inlands rather than watery wastes. So present knowledge must rest on the probability that, despite the changes of the ages, despite the shifting of seas and the liftings of lands, some part of the world's greatest and deepest ocean was also the world's earliest ocean, with the consequent probability that aquatic life began within or about its bounds. The course of development of living things from the lowly forms of the prime to the motile organisms of the deeps, on to the plants pushing out over pristine lands, then to creeping and flying things, and thence up to the era of brute strength, and finally to that of cunning and slowly brightening mentality, was far too long and devious to be traced without the constant help of fossil records; yet it is worth while to note that the rich flora of Pacific shores and the abundant fauna of Pacific depths seem in themselves to tell of long-continued and largely independent vital development. True, the field is so vast that the naturalists of the world have been able to touch it but here and there; even such vigorous work as that directed by Agassiz and described all too briefly by a speaker in this course (Dr Townsend) does little more than reveal the wealth of the province, so that what may be called, by extension of a current term, the vital statistics of the Pacific remains a sealed book. It is indeed known that the marine fauna of the Pacific is notable for the high proportion of distinct forms, the large number of unique genera and species of fishes, as well as of other orders of sea-born life. It is known, too, that the great ocean forms a congeries of faunal districts vaguely limited by latitude and more sharply defined by varying depth with the attendant changes in pressure, light, and heat from sun-kissed surface to freezing and darkling deeps where organisms must either produce their own light by obscure organic processes or live in eternal gloom; yet it would be rash even to attempt listing the species of any of these districts, much less those of the entire basin, save as a record of advancing knowledge and a guide for further research. Stretching as it does half way round the globe near the equator and thence to both polar ice-fields, ranging as it does from sunny shallows to frigid depths, and holding as it does half the water of the globe, the Pacific is a reservoir of marine vitality of capacity passing our standards of measure; the scattered facts gathered by naturalists are at once suggestive and promising—suggestive of long, long development in the unwritten past as well as of present richness, promising of future wealth when men learn to convert the seas into pastures and preserves for living things useful to their kind.

Herein lies one of the greatest and most enticing of the problems of the Pacific: How are the watery wastes and the abounding vitality of the great ocean to be reconstructed and rendered available for human benefit? When an international tribunal discussed the seal question a few years ago, two of our associates—General John W. Foster and Mr J. Stanley-Brown—were almost alone in grasping the idea that open ocean will some day be brought under human subjection as feeding grounds for useful organisms, just as are the narrower fields and pastures on land; yet the concept is growing, and the problem of ways and means is destined to become a burning one in the early future.

THE PREHISTORIC PACIFIC

It is a convenient custom to apply the term "prehistoric" to that earlier part of the human era—the Psychozoic age of Le Conte—stretching from the advent of man, either in particular provinces or on the entire globe, up to the stage at which writing arose and records began. This was the prescriptorial stage of human development, and the period, with its remains and relics of early humanity, forms the major part of the domain of archeology. Now, the archeology of the Pacific is a nearly untrodden field, and teems with problems of most attractive character. Thus the home of what would appear to be the earliest known human prototype has been found in modern Java, on the borders of the great ocean, in Tertiary deposits attesting profound geographic changes since the scattered bones were entombed. Thus, again, the uttermost island of the Oceanian archipelago, Te Pito Te Henua, or Easter Island, abounds in most impressive monolithic sculptures of a size so gigantic as to recall the Titanic relics of Yucatan and Peru, Egypt, and India, yet whose origin and age are wholly lost in the obscurity of the unrecorded past; and, similarly, various other Pacific islands contain relics or ruins attesting a former population of which no known tradition survives among the living inhabitants. No doubt the greater part of these relics await discovery, while the story of all remains to be wrought out as our knowledge of the islands and shorelands advances. So well informed a student as Archibald Colquhoun suggests that Easter Island must have been originally peopled from South America, and it is simple and easy to so extend the suggestion as to explain similarly the peopling of the more westerly islands by a stock of navigators skilled in rock carving. True, the distances are so great and other difficulties so numerous as to render the suggestion of little weight in the absence of direct archeologic evidence; yet it is worth remembering that the supposition is in line with the suggestion of Professor Cook that the palm and other tropical plants were carried westward by human agency after their character was shaped by cultivation on the American hemisphere. It was an early view that America was peopled from Asia by way of Bering Strait. This may be so; yet it is important to recall that the only absolutely known crossing of Bering Strait by a primitive folk was that of the Eskimo working their way westward from America to Siberia; and during the last decade the scientific collaborators of the Jesup expeditions about the northern shores of the Pacific have found clear indications that the mythologies of such aboriginal Asian peoples as the Tchukchi originated in America and found their way across the northern seas during prehistoric times. Both relics and traditions indicate that Chinese and

Japanese junks have been swept to American shores by wrecking storms, and it is easy to imagine the peopling of America by such accidents, or by designed voyages through the same waters in the darkness of the prehistoric; yet on the whole the indications are clearer that Asia was peopled in some part from America than that America was peopled in any part from the great continent beyond the Pacific.

If personal opinion based on original research may again be ventured, the probabilities may be summarized in this way: First, that the Old World and the New were separately peopled by autochthones—by veritable children of the soil, growing up independently from unknown ancestry in families and clans and tribes which have merged and blent and integrated into ever larger groups during the ages; second, that the chief resemblances in arts, customs, faiths, and even in languages, are the product of similarities in environment, and hence in conditions and modes of life; third, that there were occasional interchanges both eastward and westward, though these were not of such extent as materially to affect the course of racial and cultural development; and fourth, that the extensive peopling of the Oceanian archipelago may be connected with the geographic indications of relatively recent subsidence of a mountain-set land whose island crests were places of refuge for tribes and peoples displaced by gradual inundation of one-time lowlands now wholly submerged. Anent the last of these probabilities, it is to be observed that many of the Oceanians are masters of a peculiar craft or sense employed in navigating their proas and out-riggered canoes; they regularly traverse scores or hundreds of miles of open ocean beyond sight of land, without compass or sextant, by following traditional lines in the water invisible to the better eyes of Caucasians, seemingly under the guidance of an instinct analogous to our own feebler instinct of orientation, or sense of direction. The apparent homology between this sense of the Oceanian navigators and the instinct of the migratory birds which still traverse the northern Pacific (just as the European quail spans the Mediterranean in spring and fall migrations) is strikingly close; and much as the naturalist sees in the persistence of migration routes an instinct outlasting geographic boundaries, so the anthropologist must contemplate the possibility, if not the probability, that the invisible sailing lines impressed on the brains of Samoan and other islanders must date back to earlier geographic conditions when the stretches of open sea were shorter than now.

All these suggestions as to the prehistoric Pacific are of use chiefly in pointing to the problems of the great world-basin. The archeology of the islands and shorelands is no better developed than the biology of the littorals and deeps; and in either case only enough is known to sharpen the mental appetite for more and better knowledge.

THE PACIFIC IN HISTORY

Passing over the hazy legends of geographic adventure (connected chiefly with Indian Ocean though approaching the Pacific) from the fable-tinged search for the Golden Fleece by Jason and the echo of the discovery of Australia by Norsemen up to the veritable but ill-recorded journeyings of Marco Polo, the history of progressive discoveries in the Pacific comes up as an alluring tale, abounding in adventure, bristling with exciting episodes, and big with lessons for modern men and up-to-date enterprises. Seen first by Caucasian eyes when Balboa sighted its silvery expanse in 1513, the conquest of the great ocean began when, in 1520, Magelhaes—better known as Magellan—entered the basin through the stormy South American strait still bearing his name; and the progress of this plucky sailor's party westward by way of the Ladrones to the Philippines, and thence on and ever westward until the globe was girdled for the first time by human enterprise, was not merely a signal fact but a pregnant prevision—a truly prophetic portent whereof the vision and interpretation were caught with marvelous insight by the philosopher-poet Berkeley:

> Westward the course of empire takes its way;
>   The four first Acts already past,
> A fifth shall close the Drama with the day:
>   Time's noblest offspring is the last.

A pity that the poetic measure and current meaning of pre-Revolutionary days should have met in "empire," the end of the fourth "Act" (or stage in human progress) and but the painted scene for the fifth! But, after all, the essence of the fifth Act *is* empire, albeit of freedom and humanity rather than the mingled tyranny and trumpery "such as Europe breeds in her decay."

Magellan's fate, like that of many other explorers, was tragic; the killing of Captain Cook on Hawaii, and the mutiny against Captain Bligh on the good ship *Bounty* at Pitcairn Island were typical—they served to stimulate curiosity and cupidity, and guided the ever-springing ambition of vigorous men to go, to see, and to conquer.

During the last century Caucasian discovery proceeded apace along far too many lines to be followed in an hour; but one of the lines was of such significance as to demand a moment's thought. While still in the flush of national growth following the annexation of Texas, the acquisition of California, and the Gadsden Purchase, American seamen sailed distant seas and looked on new-seen isles as treasures trove; and the American Congress in 1856 enacted a law authorizing American citizens to claim, acquire, and possess islands discovered in the broad Pacific. Several were so acquired; some were taken formally and officially by the Navy of the United States. Notable among these were two of the "Line Islands" lying under the equator in mid-ocean; in 1858 Commander C. H. Davis, U. S. N., took formal possession, in the name of the United States, of Jervis Island, in longitude 159° 58′, and New Nantucket (or Baker Island), in longitude 176° 32′ (*i. e.*, within little over 200 miles of the anti-prime meridian dividing the western hemisphere from the eastern), and formally reported the annexation to the executive and legislative branches of the government amid acclaim eclipsed only by that evoked by his own record in the stirring days to follow.* During that decade as in decades before, Spain was relaxing diligence in the Pacific, Russia was clinging closely to northern shores, Portugal had passed her prime, Germany was full of the affairs of the Fatherland, the sun of Japan was not yet risen, and there was none but Britain to oppose the bridging of the Pacific by American enterprise. The day of Oceania seemed to dawn; the legion islands seemed stepping-stones for the youthful giant among nations, stepping-stones stretching to far Cathay and farther Ind. Such was America's promising place in the Pacific toward the end of the fifth decade; but even before the opening of the sixth the ardent growth-flush paled before the threat of domestic dissension, the energy of civilian and navalian voyagers was concentrated at home, and the nation withdrew for a season from the Oceanian field. Thus fell an unreckoned tax of the Civil War—a tax beyond easy summing, and one never to be paid in full. The paralysis of American enterprise in the Pacific was complete; gains ceased, losses began; the Stars and Stripes floated figuratively over Jervis and New Nantucket until 1889, when H. M. S. *Cormorant* sailed by, gorged the former at a gulp, and thrust a clinging claw through the strong Yankee aroma of the name half shielding the latter; other footholds were forgotten, and the American flag inclined homeward—until Alaskan opportunities and Hawaiian appeals rekindled the earlier flush of normal growth, and the Star-spangled Banner was again unfurled to the outer world. During the lost decades Russia reached out to Pacific ports, Germany grasped some oceanic gems, Japan jumped into the foreground of the national stage, while our insatiate cousinly—cozenly?—neighbor pursued the tiresome tactics of the Forty-ninth parallel, the Maine line, the seal islands, the Alaskan boundary, and all the rest—in the words of the down-south camp-meeting, "Jes' inchin' along, inchin' along, inchin' along to'a'ds Glory." So began, and so ended, the first era of American expansion in the province of the Pacific.

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* An account of Commander Davis' peaceful conquest with a description of the islands has just been published by James D. Hague in the *Century Magazine*, vol. lxiv, September, 1892, p. 653 *et seq.*

Meantime other, albeit feebler, forces were at work; other, albeit softer, races than the Caucasian were pursuing the paths of human destiny, paths leading ever from lower planes to higher—for of such is the course of human progress. The black men of the Austral subcontinent and of the insular bridge leading thence from man's primordial cradle on Asian and African coasts retreated before exuberant Nature, shrank from the touch of higher intelligence, fled the beast-gods of their own mystic creation; for as glimpsed by Kipling,

> This is the story of Evarra—man—
> Maker of Gods in lands beyond the sea.

The brown men of the islands and shorelands pressed forward in physical development until the Samoan excelled the Greek in bodily vigor and statuesque beauty; but since the end of the brown man's ambition was ease and comfort, with but occasional spurts of strenuous exercise, the world was not rewrought at his hands. The yellow man of the shorelands studied in a severer school and learned to spare no toil or effort, so that he rewrought his own fraction of the world in his own patient way, and raised his Flowery Kingdom to the highest rank of empire, only to stop at his own walls of exclusion. Meantime and after, a strain of brown and yellow blent, and, invigorated in the mixing after a curious law of human development, found lodgment on an island province; and there the generations were pent and trained in Nature-conquest until they developed a vigor and prepotency of blood and brain which, in the fullness of time, enabled them to take rank among the world-makers—for in this class the Japanese must ever stand. The story of China through her uncounted cycles of steady growth, through her slow but certain rise from barbaric faiths to a practical cult of the Golden Rule, through the tedious stages of germinant letters and arts, was well summarized in our course of lectures on Asia a year ago; the more acute activity and swifter progress of Japan, with the peculiar senses of humanity and artistic perfection so well developed among her folk, were clearly protrayed in the initial lecture of this course by Professor Fenollosa; while other facts and features of oriental progress are too many for easy telling.

The brown and the yellow and the mixed strain were still on their upward course when the white stock pushed across the great ocean; the contacts and interactions soon brought up a series of problems for solution by the hard processes of living experience; yet the greatest of these problems, the greatest, indeed, in all human history, remain unsolved today—and their name is Legion.

THE PROMISE OF THE PACIFIC

When the area involved is half the earth; when the continents are four out of five, and the races all of our five; when the countries are a score, the great islands a hundred, and the islets a myriad; when the population is uncounted hundreds of millions, and when the interests cover all those known to human ken, the problems of progress become too complex for full statement, to say nothing of definite solution. Yet when it is realized that the essential problems of progress *are* problems, the way is opened for statement, if not for solution, of the leading questions; for, thanks to the modern science which has been called the New Ethnology, the general trend of human progress is no longer obscure. It cannot be too firmly held and too often stated that human development may be defined by stages, each reflecting the endless series of interactions between the human organism and the environment, and each measuring a long step in mental growth. The stages may be defined in many ways; they are most conveniently expressed in terms of social organization. So defined, the first great stage (passing over the shadowy one of the prototype) is that in which customs with all the power of law are based on blood kinship traced in the maternal line, and in which the men are warriors; the next is that in which custom and formal law are based on consanguinity traced in the paternal line, and in which men become patriarchs; the succeeding stage is that in which elaborate laws, with attendant customs, are based on proprietary and hereditary rights, especially in lands, and in which men are sovereigns and subjects; the final stage is that in which formal law merges into equity based on the recognition of equal rights to life, liberty, and the pursuit of happiness, and in which men are citizens. It is true that these stages intergrade or overlap in some measure; yet the great fact remains that humanity may be defined in terms of these developmental stages more comprehensively and more usefully than by any other means thus far devised—for the stages are measures of humanity itself. For convenience they may be designated as (1) the unobserved, or primordial stage; (2) savagery, or the warrior stage; (3) barbarism, or the patriarchal stage; (4) civilization, or the monarchial stage; and (5) enlightenment, or the stage of citizenship.

With the great stages of human progress in mind, it becomes clear that a change has come o'er our dreams of conquest since the days of blood and rapine, which are to be remembered but to be deplored, and that the conquest now to be sought and wrought in the fullness of time and ever-multiplying opportunity is not the subjection or enslavement of helpless weaklings of alien blood or darker color, not the forcible capture of ill-defended lands, not the loot of stores and razing of pagan temples, but the moral conquest of lower races and more backward peoples — a conquest conducted at every step under principles of high humanity and the law of the greatest good to the greatest number. In the light of this ideal, the problems of the Pacific are simplified if not unified. Anglo-Saxon vigor has extended to every part and corner of the great province; in Japan it is represented rather by ideas and mechanical devices than by blood; in China it has been represented by the protection of the weak rather than the destruction of the strong; in the Philippines it is represented by the most patient efforts toward peaceful possession in the history of the world; in Australia, despite many dark chapters, it has been represented by the conversion of the wilderness to blossom as the rose; in New Zealand, as well shown by one of our number (Henry Demarest Lloyd), it has been represented by the world's most promising social experiment. Yet the tale of what we call Anglo-Saxon vigor is but part of the story; for the history of a century has shown that the vigorous folk of northwestern Europe came to their own in its fullness only after they had journeyed afar and engaged in new struggles for conquest over Nature and for the amelioration of their kind. So it was that America arose to the culminating plane of human progress, to the enlightenment kindled by Washington and his co-workers; so it was that Australia attained distinctive national character as a new chapter in world-history through the effects of labor in new lands, the blending of new lines of blood, and the birth of new generations; so it was also that the miniature continent of New Zealand—Lloyd's "Newest England"—reached her unique social condition after strenuous interactions between white men and brown. In the light of the law that blood is not all, but that culture, or moral force, is the final factor in the shapement of progress, the bow of promise may be seen by eye of hope to hover over the islands and the shorelands alike, about the vast expanse of the great ocean; for, in the light of this law, it is the great Nation of Enlightenment which must exert the moral force required for the reclamation of the islands of the sea and the lands beyond—

> Time's noblest offspring is the last.

Most eloquently and effectively did our last speaker—Mr. Austin—show that the Stars and Stripes now gleam through clouds of doubt and smoke of uncertainty in every part of the Pacific province; yet a still brighter feature than that of commercial conquest is that of the moral conquest, the human renovation, to which the best efforts of our citizens are directed.

And of such is the promise of the Pacific.

PROBLEMS OF THE PACIFIC—NEW ZEALAND*

By HENRY DEMAREST LLOYD,

AUTHOR OF "NEWEST ENGLAND," ETC.

THERE is a country on the other side of the world which is known to its admirers as the experiment state of modern democracy. It has made itself more talked about politically than any other country of recent times. Though a small country, it is a very large laboratory of social science. Its admirers describe it as the political advance-country of the world, so confident are they that in its evolution it is only the leader in the path in which we must all follow with our democracy; they look upon it as a sort of contemporaneous posterity, as if it were a present mirror in which the twentieth-century democrat may look his grandchildren in the face.

This country, which lies under our feet, is New Zealand, our antipodes—antipodes in more senses than one. I went there two years ago in order to see for myself what might be found out about the achievements of this country which had been so much praised as it was seen by the eyes of its admirers; to study for myself upon the ground what might be the truth in what they say.

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* An address before the National Geographic Society, March 19, 1902.

That I did not find any perfect people, any realized Utopia, any coöperative commonwealth is true; but I did find there that people of our kind confronted with our problems have found a solution so adventurous and so successful that it is of surpassing interest to us all, as much so to those who do not agree with the methods employed there as to those who do; and if it be true, as believed by its admirers, that the democracy of the future is rising in this new land of human rights in the Pacific, then those results are of especial interest to us, because they mark the path along which our own future is to go.

New Zealand is like Japan, a country to the south of the Orient what Japan is to the north. It is like Japan in the beauty of its climate; in the beauty of its scenery, which wins the hearts of all comers. It is like Japan, very windy, except that in the New Zealand Parliament they have a time limit on speeches, which is very rigorously enforced. The scenery of New Zealand is an epitome of the best scenery of the world. There are Alps as glorious as those of Switzerland; lakes as beautiful as those of England; mountains among the highest and grandest in the world, as grand as those of Norway, and rivers rivaling those of the Orinoco and the Amazon. There are beautiful flowering trees, spreading their canopy of pink and white and purple over the landscape, with the red tree, the king of all.

There are some earthquakes and volcanoes there, and you will learn from the conservatives of New Zealand that the old-age pension laws, labor laws, and some of their other innovations are among the most dangerous of their earthquakes and volcanoes.

A traveler from a country so far away is expected to bring with him at least something of the marvels which are to be found there; but New Zealand, let me impress upon you, is not a country of the abnormal, neither in the home nor the nation; neither is it abnormal in its social life. New Zealand is a country of the normal. It is normal in its natural characteristics, in its people, and from my point of view it is normal in its institutions. They have, however, one thing which might possibly bear mentioning in passing, because it appeals to the curiosity of the traveler, and because, like so many of their natural features, it is an allegorical metamorphosis. They have a caterpillar that after death turns into a plant and blossoms and goes to seed, and to all appearances it does so in the plain way that is usual with the cryptogams, to which family it belongs.* But it has been stated that there is a certain parallelism between the metamorphosis which takes place in the case of the New Zealand insect and that which takes place in the human world; but there is this difference between the change which takes place in the human case and in the case of the New Zealand insect, the human worm in New Zealand does not wait till death to blossom.

Every country must be either an experiment or an efflorescence. Japan has flowered into that exquisite art which has done more to influence the esthetic development of mankind than anything since Greece gave the Milo to art, and New Zealand has flowered into democracy. There waited the last piece of virgin soil on earth where Britain's race could expand its governing genius, its institution-making genius—for our genius to govern ourselves, I hope, is an institution-making genius. There waited the last piece of virgin soil on earth where the race could expend its governing genius and free from the slavery of monarchical vested rights, and, what is worse, vested rates—free from the unfulfilled seductions of power a subject race.

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* The insect is the "white grub," or larva of the May-beetle (*Lachnosterna fusca*); the fungoid plant which springs from its head is the "white grub fungus" (*Torrubia ravenelii*).—W J M.

Never was there a race with the strength of mind and the strength of body like that which British colonists found in New Zealand waiting for them. Of the strength of mind of the Maori you may judge by a remark made to me by one of them, who said, "They came to teach us to pray to God, and as our eyes were uplifted in prayer they stole our land from under our feet." The larger parties of Maori on the warpath found their enemy famished for the want of food, helpless from weakness; they did not fall upon him and exterminate him as his brothers in all Christian countries would do. They proclaimed a truce and sent their enemy a full half of the finest provender in their larder. This was not from any motives of magnanimity, but because they, first of all, wanted a good, square, stand-up fight, and wanted to fight well in order that they might rest well.

This strength of the Maori arises from a peculiar situation in the conditions of New Zealand. Although theirs was this exquisite country, perfect in soil and perfect in climate, although it was a beautiful house when the first Maori lived there, it was an unfurnished house. The Maori had to fight so hard for their living that they acquired the vigor that enabled them to struggle with equal ardor and equal strength for their rights. And hence it is that in this splendid new country it is their work which has counted in raising to such height its social and legal rights; and in these they are thoroughly recognized as factors—you see the Maori policeman walking right by the side of the English policeman, equally respected, equally feared. The Maori shares the same benefits in the land laws and in the other institutions of the country. There are two Maori sitting in Parliament, and since I was there a Maori gentleman, a real gentleman, has been called by the government into the cabinet and now sits beside the premier, one of the magistrates to hear and decide upon questions of the country.

This perfect land that I have described to you is inhabited today by the most perfect Anglo-Saxon people to be found in the population of the world; English principally, then Scotch, and just that touch of Irish which is needed to give perfection; and this population constitutes today the most homogeneous, the most compact, the most energetic, and the most manageable democracy in the world. And in tracing some of their recent achievements, bear in mind that New Zealand was not settled by exiles, patriots driven from home, nor by martyrs seeking freedom of religion, nor by social enthusiasts seeking to found a new and perfect state. Not at all. New Zealand was settled by middle-class capitalists, almost all of whom were merely seeking to better their condition. The English gentleman left the social question behind him when he went there. He took with him political questions, probably because he was an Englishman; and it came to be that by 1890, when only 50 years old, New Zealand, the youngest of the nations, found itself the oldest in economic iniquity and sin.

The people found themselves caught in the strongest grip of the modern social problem. There was the land monopoly, almost worse than that of Ireland, because it was not only a monopoly of absentees, but the absentees were corrupt, and there was not in New Zealand, as there was in Ireland, the alleviation of representation in the Imperial Parliament—an alleviation for the Irish, not for the Imperial Parliament.

There was also the money monopoly, which in the country and in the cities was in the hands of a few men who had learned how to combine and keep the screws twisted about the necks of the rest of the people. These two monopolies had done what monopolies always do—they had gotten control of the government; and the government of New Zealand was a government of monopolists, by monopolists, for monopolists, and there followed the result which always will follow on the application of such power and such motives in so wide a field as that of human welfare. The farmers in the country were effectually turned into tramps on the roadside; they were followed there by the farm laborers and by the country tradesmen, and the cities became centers of congestion of the entire population. Then those scourges of our modern civilization—shelter houses—were established; soup kitchens followed. Then began an exodus of the best blood of the land, the young men and women from the farms, brought up on farms, wanting farms, knowing how to farm, having money and stock, and taking them to find footing in another land. All this because the monopolists wanted the soil.

At this moment occurred what proved to be the turning point in the history of New Zealand—a great labor strike, called the miners' strike, followed by a strike of the seamen of the companies which controlled the steamship lines running between New Zealand and Australia and the rest of the world. This was fought in extreme bitterness and brought the country to the verge of civil war. But the strike was a failure.

Just why this should have broken the heart of New Zealand it is difficult to say, because New Zealand is not a workingman's country. Like our own country of America, it is particularly an agricultural country. But they had learned the secret of sympathy with others who are oppressed, and could sympathize with the workingmen. Whether it was that they were then ready to move and unite, and wanted some one to give the initiative, and that the workingmen gave this initiative, it would be hard to say. But whatever the reason was, the people of New Zealand turned to find a remedy, and they did find it. There was only the one side on the next election day in New Zealand. It stood for the workingmen, with the exception of a very few of the conservative party. It was a revolution. One of its leaders said it was a substitute for the French revolution. It was a bloodless revolution, but it was a revolution.

You know that in times of great public suffering and calamity, in .times of panic, there is a natural tendency to turn toward a revival of religion. In this case the people of New Zealand turned to a revival of religion, but in their case it was a revival of democracy, the best kind of religion.

Now, to show you I am not using too strong a word when I describe this as a revolution, let me give you as rapidly as I can a compact review of the things which have been done under the inspiration of this revolution. I think I shall be able to make good to you the proposition that there is scarce to be found in all history the equal of this movement; neither in the number of problems attached, nor in their novelty, nor in the success of the movement has there ever been found anywhere in the world by any democratic people an equal evidence of the breadth and political capacity of the common people.

New Zealand had been a country of landlords, yet the system of tenants was entirely revolutionized, and in its place federal ownership of the public land was substituted. A tax was placed on land and on incomes, and these taxes were naturally made progressive, so that the more land a man had and the greater his income the more taxes he had to pay. By this means the government accomplished what was their darling purpose, the abolition of the millionaire and the pauper. New Zealand is a lovely country, entirely devoid of the ordinary assailants of animal and vegetable life. But the worst of pests came to them—the social kind. When the New Zealander talks of social pests he means the plutocrats and the paupers, and in order to remove them he removed the false credit system of government. In the construction of their public works the directors have been abolished to as great extent as possible. The New Zealand public works, the New Zealand railways, bridges, and school-houses are constructed by the government, which makes contracts with its own laborers without the intervention of the director.

Then the land system was changed by means still more thoroughgoing than this: the government began to take back the land, in order to break up the land monopoly. It did this in two ways: one was purchase by negotiation; the second was purchase by condemnation, if owners were not willing to sell.

The land itself was then cut up into smaller tracts for the benefit of the farmers; and they especially recognized in their distribution the young men and women whom we saw leaving during the exodus, by giving garden and suburban spots to such as wished to live in the country. For such there are special trains to take them to and from their work; they have a road which makes special rates and runs special trains. That is what the government has done for them; but in New Zealand the "government" and "the people" are interchangeable terms, and the people in the cities have clothed themselves with power to take by the same methods of condemnation any new tracts of land, which are then subdivided and sold to the inhabitants in small tracts.

To describe this system fully at this moment would not be possible, but briefly it may be stated that when the land with all its advantages goes to its new owner it can never again be rolled up into great estates and never again be allowed to lie idle. This land must always be kept in use and can never again be consolidated into the great tracts held by the land monopolists, who made the revolution.

The railroads are also the property of the people in New Zealand. The first thing the revolution did was to place them in the hands of a minister for railways, with a seat in Parliament, for the express purpose of making the railroads responsive to popular pressure, which has been the result.

They have adopted a system of factory laws more minute, more advanced, and more progressive than those found anywhere else in the world. One of them forbids any woman to work in a factory until her new-born child is at least four weeks old.

They worked out their great method of dealing with the labor problem of the world, an experiment the success of which has been phenomenal, by means of compulsory arbitration of labor disputes. And so today New Zealand is a country without strikes, and for the past six years has been the only country in Christendom which has presented the spectacle of a country without strikes.

There cannot be a panic in one country of the world that does not show itself in the others. The panic of 1893, traveling on its path of destruction, reached Australia on time, and struck it, and struck it hard, on the first of May, 1894. There were then in Australia, in full and flourishing operation, nine hundred million dollars of capital. Six weeks later there were only four hundred and fifty million; all the rest had been swept out of existence in six weeks in consequence of the panic.

This monster started for New Zealand, but it never arrived there. The people took possession of the principal bank, took it with the full consent and approval of the owners. The government said to the people of New Zealand and to all the world, "This bank has behind it the undivided resources of the whole people of New Zealand." That bank stood, and that bank stands today. All the business houses and manufactories and other institutions stood, and of all the places in the world the only one where the panic of 1893 was never able to set its foot was in the home of the New Zealand democracy.

The necessary funds to avert this evil were raised by a means so simple that when you hear what it was you will feel as the friends of Columbus did when they learned from him how to make an egg stand on end.

The people of New Zealand, acting in their collective capacity as a country, went into the London money market, and there, upon their security as a people and their government bonds, they borrowed fifteen millions of dollars at the low rate of interest which a nation of good credit can always command. This money thus borrowed so easily and quickly in the London money market by these new-fashioned democrats was brought home and loaned out to themselves as individuals at the low London rate plus only a small percentage necessary to cover the cost of the operation and the risks. The rate of interest was at once cut in two, and this not only for the people who borrowed, but the government cut in two the usual rate of interest and fixed the rate for the entire country.

Now, notwithstanding the losses incurred—through mistakes of the government, through fires and other losses, through mistakes of single borrowers, through fraud of all kinds, in principal and interest—not one cent, either of that borrowed by the government or the people, not one dollar of principal or interest remains unpaid.

The government of New Zealand did more than this. Following the lines of least resistance, they saw that the government of the people, being for the people, as an economic concern, could be made as well a political concern, and could become, through these powers of coöperation, a factor in their daily lives. They would make it a part of their economic capital. The people and the government of New Zealand stand today as the partners of each other in their industries to an extent unknown elsewhere. They have established what you can perhaps best understand as a sort of family, or Government & Co. Unltd. It investigates the secrets of various kinds of production. It builds railroads so as to stimulate farming industries. It buys a mining patent—a cyanide patent, for instance—and then throws it open to all the people without cost. It provides facilities to the people of selling their produce in the foreign markets. The government will inspect the butter or the cheese or the meat, and if all right will approve it for export.

The government has erected large warehouses, with cold storage free. So far has this system been carried in South Australia that the South Australian farmer, desiring to market a flock of sheep, drives them to the nearest railroad station. He need not follow the sheep any farther. The railroad delivers the sheep to the harbor, where they are left on the wharf. The government then takes these sheep and transports them to the nearest port and there undertakes the business of slaughtering, especially accounting to the South Australian farmer for all the products, the hides, the wool, the meat, etc. The products are then shipped by the government to London and consigned there to the house in London which represents the South Australian farmer, and, to make a long story short, all the farmer has to do is to wait at home until he receives back through the post-office the government check for the proceeds of the same. He does not even have to wait as long as that for all his money, because the government will advance to the South Australian farmer a certain proportion of the value as a loan.

You will remember how the farmers in Kansas and Nebraska, when the bankers were borrowing money from the government under the subtreasury scheme, proposed that the Government of the United States should loan them something on the value of their crops, as it lends money to the holder of government bonds. Do you remember how that was greeted by all the statesmen and the editors? How these unfortunates were branded as anarchists or something even worse than that? And yet today precisely that same scheme is in actual and successful operation on the other side of the world among a people of related blood, of related institutions, and of related political affiliations.

But while we were doing that the people of New Zealand, as a sort of side issue, gave woman the suffrage. It seemed to them so much a matter of course that a real democracy should not allow any portion of their community, and the best part of it, to be disfranchised that the bill went through in one night, practically without a single dissenting vote.

This last fall New Zealand, first of Christian nations, out of the proceeds of the general taxes, gave its destitute old men and women the old-age pension.

Step with me into the chamber of the minister of railways and get a glimpse of what it means to a people to be the owners of their own highways. All are free to discuss where the lines shall be built, how they shall be operated, what the rate shall be, and so on. Everything is a matter of public discussion—in the newspapers, in the commercial bodies, in the homes, it is the privilege of all to discuss these questions, as they know that the roads are not to be used to make a profit from the people, but are to be used to give the people a great necessity of life at the cost of production. So far is this principle carried that as rapidly as the profits show a tendency to increase, the government cuts down the rate; and this is being done all the time. They are not to be used as a means for fleecing the people. There are different ways of fleecing the people on the railways of the United States. Last year there were killed in all eight thousand, to say nothing of fifty thousand wounded. The death roll of the war was not as great as that of the railways. But in New Zealand, under this public administration of the precept of the highest good to the greatest number, there were killed last year of employés and passengers—not one; and yet by their mileage statistics they were entitled to have killed at least two hundred and fifty.

The traveler will not find the railways equal to the American railways, although in some respects superior. There are no air brakes on them, but neither are there any records of their having been needed. There is no continuous cord through the train, but neither are there any private cars. There is no continuous passage through the train, but neither is there any *credit mobilier* burrowing its way. There are no dining-room cars, neither any merchants' fast lines nor fast-freight lines. The rates are the same, even if it is the treasurer of the road; such a thing as a special rate is unknown. No one could get a special rate. A merchant shipping ten thousand tons could not get a lower rate than one shipping ten tons, no, nor one shipping a million tons. A preferential rate given by an officer of a road in order to enabl his friends to run his business is unknown. So you see what it means to have the railways owned by the people.

I stood on the railway station at Wellington and saw a train full of children, many of them copper-colored Maori boys and girls, on a school excursion. A series of these is arranged by the government of New Zealand. The children are brought down from the back country into the city to see the ocean harbor and the steamships and the wharves of the great metropolis, and all the sights of a busy city. The government arranged another train as large, which rolled out of Wellington, taking the city children up into the mountains to see the trees and look at the robin, and to hear the crow which there sings the sweetest notes. They were carried out at rates so low that children fifteen years old were carried a hundred miles and back for fifty cents. They carry children to school in New Zealand on these roads.

Of course there is no profit in doing this business at these rates, but I think the people of New Zealand will see their profit in the health of the future fathers and mothers and in the intelligence of their future citizens ; and so you see a democracy can make money by losing it.

Let us make a rapid trip to the scene of some of these land operations. There could be nothing more interesting than that. We will go to one of the places where the government has purchased one of the great estates by condemnation, compulsion being ordinarily unnecessary. The owners are usually willing to sell. The owner may be of an advanced age, and he is easily persuaded that his lot would be much pleasanter if he should spend his declining days in cutting coupons and living in clover. He never really does live in clover, you know, but it sounds well.

At Argyle the government had to condemn an estate. They put a woman on a farm of thirty acres. She tells of the passion for land that she had, that had always run in her family. "Why," she said, "the dirt runs in our blood." We looked at her closely, and, seeing the clear, strong face, we thought she was right.

Not far from her is a farmer. He tells how he used to have to work, and take the wages that he was offered. "I go outside to work now only when I have nothing to do upon my land. I go on my horse, and there are potatoes enough in that field to buy the land."

So one of the poorest classes, known as the "cropper," having no capital of his own, compelled to pay his rent by giving an extortionate share of his produce, said: "This rent now under the government is a very different thing from what it was under the former proprietors. And do you know why, sir? The reason is this"—and, indeed, that is the secret—"the reason is that the people want to make little profit out of the people."

In the old days this great estate, from the river on the south to the forest on the north, as far as the eye could see, was owned by one man. The government has taken possession of the land, and now, where there was only one man, there is a population of two thousand people. Now you hear the school bell and the church bell, and the people by their own industry are becoming the proprietors of the land.

And under this system of democratic administration the produce of this land is fourteen times what it was under the monopolists. There is fourteen times as much wealth in wheat and produce as under the old proprietors, to say nothing of the infinitely greater wealth of home and happiness and life.

There was one man, who was a fine type of a worthy Scotchman. He tells of how the former owner was making a tour of the estate with a friend from England. He was feeling pretty good and desirous of showing off, no doubt. He said, "Well, Bruce, wouldn't you like to have a piece of this land?" "Yes, sir; I would, sir." "That is as near as you will ever get to it, Bruce," responded the rich man. Today we find Bruce on that identical spot, the owner of one hundred and fifty acres. We find him raising eighty bushels of democratic wheat to the acre.

Let us go down to a town where tomorrow morning there is to be divided up among the people one of the great estates which has been taken by the government from the former owner by voluntary negotiation. We find the town filled with people, the very cars on the track used as lodging-houses. The people have come to see the distribution of land on the morrow, and to take advantage of the last opportunity to make a part of that distribution. The method of distribution is worthy of our special attention. They have been waiting for weeks, yes, for months. The land commissioners have been sitting in their respective places to receive applications from those who wanted a chance to get a farm, which is only given to those who are competent to use the land after they have taken it. For months the land had been advertised—the property as it was, the convenience of access, and so on. The necessary investigations are delicate matters, involving the disclosure of personal affairs; but knowing of my efforts in New Zealand and desirous that I should know as much of the operations as possible, the judges allowed me to sit by their side. I have seen few things more interesting or more dramatic than I witnessed as I stood there in the court-house and saw the stream of men and women passing through and listened to the sound of their feet.

There was one man who had for thirty years been working the land. There was a fine, buxom woman, the mother of a family, who applied with her husband. "If I get it, it is his; if he gets it, it is mine," she said. There were three red-cheeked dairy maids who had applied together to triple their chances to get it. Beside the moderator sat the professor of agriculture in a neighboring college, who had to confess that he did not know much about farming. A man from Oklahoma, who had been all over the world, said to me, "It isn't much like Oklahoma, is it?"

And the next morning was the meeting in the court-house, and the streets were full behind it, with the women all pushing forward to the front seats, for it is not considered the thing for the men to have the best places.

Now, these distributions are arranged very simply. All the applications for these farms are put on a sheet and numbered. Then twenty balls, numbering from one to twenty, are put in the ballot-boxes, and these are drawn out, and the number corresponding to the number on the sheet gives the lucky name. These good democrats selected a person who had come from America to represent them in doing that duty, and so upon this occasion it was my happy duty to distribute among the democrats of New Zealand the great estates taken from the monopoly, and never have I done and never will do anything that can give me more satisfaction, unless on some happier day it should come to me to do the same thing for my fellow-citizens.

And so, as each farm was called out, I placed in the box the requisite number of balls, kept my eyes off the balls, closed the door, and stood with my back to it ostentatiously, put my hand in and drew out the ball, read the number and read out the name of the happy man; and as I picked out balls with the number I saw some flashes of pleasure light up the faces of my dairy maids. They had gotten their farm. It was not much like Oklahoma, was it?

But I want to tell you of how they deal with the unemployed, which is one of the great triumphs of New Zealand politics. Come with me to the viaduct where the government is building a great railway bridge, among the green trees through which gleam the white tents of the workmen. The government gathers up in the streets of the cities and the country roads the men who want work. Their wives and children are taken with them, because New Zealand people do not believe in separating a man from his family. The man, with his wife and children, are placed upon railroad trains, for the journey is a long one, given lodgings at night, and cared for until they come to the scene of their labors. There they find a government officer in charge of tents of shelter. They are given instructions to work and tools to work with and land of their own to settle upon.

Some who take up land do not know how to farm and have no funds. They are given the land, tools to work it, seeds and teams to plant the land, and are given instructions as rapidly as possible, taught to fell the forest trees and raise the crops, and the government advances them money. We say they are given this and that, but they are *given* nothing. They have to pay for the land, and so well and surely is the scheme managed that they do pay. Their time is divided off, half for themselves and half for the government.

There are many other interesting things to tell you about, but we will pause only for a moment by the side of Magistrate A—, who asked me to sit by him to see him administer this new act of mercy and justice, the old-age pension law.

It is unnecessary for one to be a pauper to become a pensioner. One may have an income of thirty-four pounds a year and still receive a pension, or he may have eighteen pounds a year and still receive a full pension. No, New Zealand is not encouraging the people to become paupers. There are many things to prevent. One may have committed a serious crime or one may be an habitual drinker, and, if so, he cannot get a pension.

It is an international sight to see put into political effect the precepts of Christianity. We look upon the old men and women as they come to be asked questions, and they all kiss the Bible (which is a most unsanitary proceeding, apt to reduce the number of pensioners). Each one must answer as to whether he or she has ever been in prison. One old lady among the applicants had a face so refined and pure the judge could not bear to ask her such a question as that. He looked at her with the utmost benignity as he said, "Now, have you ever been in any trouble?"

The dear old lady said, "Why, yes; I was alone in the house once for six weeks." She had not understood him at all, and so he had to repeat the question in the plain language of the law.

Another thing—they must answer the question which comes in the insurance policies—their age.

And there were a few women, and they all told their age—sixty-five years. New Zealand is the only part of the world where I ever saw a woman of a certain age willing to tell her birth-year. There was a widow who had recently married, and she had given her age as younger than she was, and this year she had given another age in order to get the pension. "I am exceedingly sorry," said the judge, "but you can't give one age to get married and another to get a pension."

There was one very forlorn-looking woman, so old that all her friends had died; every trace of her birth had disappeared, the Bible was gone, her marriage certificate even lost. Then the judge said in the kindliest way, waiving the question of other evidence, "No matter; you look it," and as she heard the words a smile of intense gratification spread over her face.

The New Zealand people say there is nothing which has given them greater satisfaction than the old-age pension law, and you will perhaps understand their satisfaction when I quote this sentence from an official report: "Owing to the old-age pension law, the aged tramp has disappeared completely from the highways of New Zealand."

Think of a country where the aged tramp has disappeared. Not because he has been trampled down nor put in the poor-house, but because he has been lifted up by the mercy and generosity of the people to a position of security.

Now, there are five proofs of the accuracy of what I am reporting to you. I will give you, briefly, five tests:

First. The will of the New Zealand people, as shown by their elections. The majority of the democracy party has been increased, until today it is stronger than ever.

Second. The experiments of the New Zealand railways, the public works, New Zealand State life insurance have all been successful and are making money.

Third. The country is proceeding still further in the way of its compulsory arbitration. Another point is the success of the experiment made by the legislature of New Zealand, the most interesting of anything done by any legislature of the world—meeting the excesses of the pools and trusts by having the government go into the coal business.

Fourth. The experiments of New Zealand are being imitated by the neighboring nations. Its compulsory arbitration system is in successful operation in New South Wales, Western Australia, and Tasmania. Then the old-age pension law has been adopted by Victoria and New South Wales. If New Zealand is so far on the road to ruin as has been so often said, its neighbors would certainly not be undertaking to follow it. Its customs duties have increased, the number of income-tax payers has doubled, and its net taxes have increased 75 per cent in the last five years.

The New Zealand people, among other freaks, possess a very curious creature called the "wingless bird." When these various experiments in New Zealand set in, the capitalists and monopolists said, "It will ruin the country, and we will certainly leave. We and our money will take flight together."

The people introduced these experiments. They were successful. The country is prosperous.

The capitalists did not take flight. They stayed to share the prosperity. They are now pointed out as the most interesting species of New Zealand's wingless birds.

SUMMER MEETING OF THE AMERICAN FORESTRY ASSOCIATION

An exceedingly interesting and profitable meeting of the American Forestry Association was held at Lansing, Michigan, August 27 and 28, 1902, under the joint auspices of the Michigan Forestry Commission and the Michigan Agricultural College. The first session was held in the State Capitol, the second and third in the Botanical Laboratory of the Agricultural College, and the final sessions in the State Capitol. Hon. Charles W. Garfield, Vice-President of the Association for Michigan, presided at all of the sessions.

At the conclusion of the meeting an excursion was made to the Michigan Forestry Preserve in Roscommon and Crawford counties, and thence to Mackinac Island, under the guidance of the members of the Michigan Forestry Commission, Messrs Charles W. Garfield, Arthur Hill, and Edwin A. Wildey.

While the papers read and discussed at the meeting were selected largely because of their application to practical problems in forestry and forest management which today confront the people of Michigan and adjacent states, yet it is believed they contain much information of interest to members of the National Geographical Society. We present below short abstracts of the more important papers. The papers and the discussion thereon will doubtless appear in future numbers of *Forestry and Irrigation.*

A. J. H.

THE MICHIGAN FOREST PRESERVE

BY THOS. H. SHERRARD,

BUREAU OF FORESTRY

Mr Sherrard's paper gave a general description of the physical characteristics of the Michigan Forest Preserve and an idea of the original forests of magnificent white and Norway pine which the preserve once supported. The existing forest covering was classed under five types—swamp, jack pine plain, oak flat, oak ridge, and hardwood land. A scale map was exhibited, showing the distribution of these types in a representative township, and an estimate was given of the possible production of a second crop of timber on these lands, based upon the measurement of existing second growth. An organization was recommended for the practical management of the preserve, which it was estimated would cost $3,000 a year, or five cents per acre. The prime necessity for the maintenance of a fire service during dangerous seasons was urged. The offer of coöperation by the Bureau of Forestry with state organizations was explained, which affords an opportunity for perfecting a sound forest management for the preserve. Mr Sherrard gave an instance of the coöperation of the Bureau of Forestry with a private owner in the management of 100,000 acres of cut-over hardwood forest in northern Michigan.

RELATION OF SOILS TO DISTRIBUTION OF FORESTS IN MIDDLE MICHIGAN

BY PROF. BURTON E. LIVINGSTON, Ph. D.,

OF BOTANICAL DEPARTMENT, UNIVERSITY OF CHICAGO

Prof. Burton E. Livingston, of the Botanical Department, University of Chicago, summarized the results of a number of years of study of the flora of the southern and middle counties of the state, and especially of a detailed study of plant distribution in Kent county made last year. A similar study of Crawford and Roscommon counties is now being made by him. The conclusions reached by Professor Livingston were mainly these:

(1) The nature of the soil determines the nature of the forest.

(2) Variations in the chemical nature of the soil are probably not effective in this way in a region of glacial drift.

(3) Variations in the physical nature of the soil are probably the main factor in determining our forest distribution. By physical nature is meant the power of a soil to retain moisture, its so-called "capillary power." The results of an excess or deficiency in moisture is shown

in swamps and barren lands, while tracts moderately drained are covered with a heavy forest growth.

(4) The capillary power of a sandy soil may be increased by the addition of either clay or humus.

FOREST BOTANY SUGGESTS WHAT FOR THE NEW FORESTS OF MICHIGAN?

BY PROF. CHARLES A. DAVIS,
UNIVERSITY OF MICHIGAN

Professor Davis presented a number of suggestions for improvement of forest conditions in Michigan in the light of forest botany. These suggestions may be summarized as follows:

(1) All vegetation which will grow should be protected in order that the soil may be covered.

(2) Tree species, especially such as will grow on lands of the class available, must be protected from fire and cattle in order to reach commercial maturity.

(3) The tree species now growing upon these lands serve as nurse trees and soil cover until more valuable kinds can reëstablish themselves, and will become a source of revenue if allowed to develop.

(4) The white pine will grow upon much of this land, and there is no foundation for the current popular belief that this species will not grow in old pineries.

(5) Belts of oak and poplar, both of which grow readily and are somewhat resistant to fire, could be planted for fire protection.

(6) Foreign species, or those from other parts of the country or other soil conditions, should not be extensively planted until thoroughly tested in experimental tracts.

THE MANAGEMENT OF MICHIGAN HARDWOOD FORESTS

BY WALTER C. WINCHESTER,
GRAND RAPIDS, MICHIGAN

Mr Winchester's view of the forests of Michigan was that of the practical lumberman. He described the conditions at present existing, and reviewed the operations of the lumber industries. "The lumberman buying timber lands today," said Mr Winchester, "is naturally not in sympathy with the principles of forestry." All the products of the forest are utilized; even the ferns growing in the timber are picked and sold in the Chicago market to florists. In Mr Winchester's view the taxes on timber lands are very high, and some remedy must be found in the way of a rebate of taxes to persons who are willing to hold their lands after cutting off the mature timber. In his opinion, the undergrowth, which springs up very rapidly on hemlock and cedar lands, will keep the ground from drying out. The protection of trees of fifty years' growth and under is necessary to preserve large areas of hardwood lands for a new crop. The enactment of taxation laws was urged with this object in view, which would make it a business proposition.

THE JACK PINE PLAINS OF MICHIGAN

BY PROF. FILIBERT ROTH,

GENERAL LAND OFFICE

Professor Roth's paper was an interesting discussion of the important function of the jack pine in covering up and restoring the waste lands and sand plains of the Lake States area. He described the barrenness and desolation of much of the land found to be too poor for agriculture and abandoned by the farmer, who waits for the forest to heal up the many scars he has inflicted on the land. "Fortunately for the Lake States," said Professor Roth, "there is a climate and there is a tree which make this possible and which in time will heal and cover up the dreariest sands. This tree is the pretty jack pine, that frugal scrub among the stately race of northern evergreens. A fertile seeder, with long, closed, resistent cones, a rapid grower, with abundance of crown and foliage, this tree spreads over these barren lands, whether abandoned by other forest trees, ruined by fire, or left to waste by the farmer." The peculiarities of the species were described and its usefulness shown in furnishing a substitute for Norway and white pine, while preparing the way for the return of better species, securing the land against impoverishment, and protecting it when reclaimed.

THE CHIPPEWA FOREST RESERVATION IN MINNESOTA

BY HERMAN H. CHAPMAN,

SUPERINTENDENT STATE EXPERIMENT FARM, GRAND RAPIDS, MINNESOTA

Mr Chapman outlined the forest conditions existing in Minnesota which led to the recent action of Congress in establishing the Chippewa Forest Reserve. One-third of the State of Minnesota is pine land, which has been cut over. A great portion of it is unfit for farming, and the problem for determination is, What shall be done with it? The difficulties in the way of forest reproduction on lands long cut over and abandoned to fires and brush were set forth. Mr Chapman held that practical steps should be taken at the time of cutting the pine. Reforesting should be directed either by state or national authority, and in Minnesota the best opportunity lay in the direction of national control. The recent bill provides for a forest reserve of 200,000 acres, to be under the control of the Chief of the Bureau of Forestry in the United States Department of Agriculture, who shall regulate the cutting of the timber, save seed trees, and protect from fire. Mr Chapman expressed the belief that under wise administration of this measure the pine may be perpetually renewed on this tract.

THE CLIMATE OF THE WHITE PINE BELT

BY PROF. ALFRED J. HENRY,

U. S. WEATHER BUREAU

"The Climate of the White Pine Belt" was the subject of a paper by Prof. Alfred J. Henry, of the United States Weather Bureau, Washington, D. C. Professor Henry pointed out that the white pine reaches its greatest development in that part of the United States which is also the great highway of cyclonic storms passing across the country from east to west to east, viz., the watershed of the Great Lakes, the St. Lawrence Valley, and northern New England. The climate of this region is characterized by a fairly uniform distribution of precipitation throughout the year, a high percentage of humidity, much cloudiness, and the absence of droughts and hot, dry winds. Although vast tracts of timber have been removed from the forests of this region, no appreciable effect appears to have been produced in its climate.

THE SHIFTING-SAND QUESTION

BY DR JOHN C. GIFFORD,

CORNELL UNIVERSITY

Dr Gifford, who has visited most of the shifting-sand districts both of this country and of Europe, pointed out that the forest performed simultaneously two very important functions in this connection—soil betterment and soil fixation. He explained the necessity of cutting off the supply of sand from the sea by the use of wattle fences, beach grass, bay berry, etc. Many instances were cited to show how sand soil had been both chemically and physically improved by the forest and how it had been thus prevented from doing serious damage to other more valuable property. The reclamation of these sandy lands is of importance because they are usually located in places along the sea where the land is valuable. All these sand lands demand a treatment peculiar to each locality, depending upon the wind, the climate, the nature of the sand, etc. Shifting sands may be divided into two great classes—those along the sea and large bodies of water and those inland. There is less trouble with these sands in this country than in Europe, because, with the exception of some sands in the Great Lakes territory and along the Pacific coast, the prevailing winds are from the west. He described the methods employed in southwestern France and along the Baltic and North Seas. He spoke of the dunes of Michigan and Florida and the sand hills of Nebraska, and described the work done in various sand districts at home and abroad.

THE PERIODICITY OF TREE-GROWTH

BY PROF. E. E. BOGUE,

PROFESSOR OF FORESTRY, MICHIGAN AGRICULTURAL COLLEGE

Professor Bogue presented the results of an investigation of the time as well as the amount of growth of twenty-nine young trees during a period of thirty-five months. The relations of tree-growth to rainfall, frost, and other meteorological conditions were also explained.

THE TRESPASS PROBLEM

BY ERNEST BRUNCKEN

Mr Ernest Bruncken, of Milwaukee, the secretary of the late Wisconsin State Forestry Commission and a well-known writer on forest matters, read a paper on "The Trespass Problem." Public sentiment, he said, did not look on timber-stealing as a crime. The reason was that the government's ownership of its forest lands was not based on labor and care expended on them, but merely appeared to withhold from the citizens that which nature had freely given to all. The remedy was to bring the public forests under forestal management. When the money of the tax-payers was expended on their protection and improvement public sentiment would no longer countenance timber-stealing. Forestal management implied a force of men on the land to protect it. Among the practical measures advocated were a proper demarcation of the boundaries of forest reserves, their consolidation by acquiring title to private holdings within their limits, and the rapid disposal of all state lands to actual settlers, except those to be held permanently as forest reserves.

THE FIRE PROBLEM, AND HOW TO SOLVE IT

BY H B. AYRES,

U. S. BUREAU OF FORESTRY

At the outset Mr Ayres insisted that fire protection in Michigan depends upon Michigan people. The variety of forest conditions in the state, as influenced by the Great Lakes on the one side and the Great Plains on the other, was noticed, and the constant danger of disastrous fires pointed out, together with its unfavorable effect on timber-land values. Methods of providing against fires were discussed, and the experience of Minnesota, under conditions somewhat similar to those in Michigan, was outlined. An awakened public sentiment, with a constant pressure for the enforcement of legally established measures of defense, is necessary. Mr Ayres summed up the duty of the community at large in a few words: "Let local societies be formed in every community, and let the subject be kept alive, studied, discussed, agitated. Get the people to act earnestly, systematically, persistently, and the fires will be stopped."

MINNESOTA'S SYSTEM OF PREVENTING FOREST FIRES

BY GEN. C. C. ANDREWS,

CHIEF FOREST FIRE WARDEN OF MINNESOTA

General Andrews, who is now serving his eighth year as Chief Forest Fire Warden of Minnesota, described the system in force in that state against forest fires, which is mainly one of prevention. Town supervisors are made fire wardens, who can summon males upward of eighteen years of age to help extinguish fires. A central officer enforces the law. County commissioners award the pay for local service, the state contributing one-third. Some counties are backward in paying, and uncertainty of pay is the weakness of the system. It would be more effective were the state to pay two-thirds and counties one-third. In General Andrews' opinion a great forest fire cannot be extinguished by human power, but can be prevented. The Minnesota system has helped to educate the public to better care of the forests.

THE FARM WOODLOT

BY FRANK G. MILLER,

U. S. BUREAU OF FORESTRY

In Mr Miller's opinion, the planting of forest trees for protection and ornament is commendable, but too much planting has been done with these objects alone in view. Too little attention has been paid to planting trees for profit, and to this omission is frequently due a failure to attain fully the other two objects mentioned. A well-kept woodlot is not only a source of revenue in the posts, cordwood, and materials for farm repairs it furnishes, but it gives character and adds beauty to the home. The appreciating prices of the products of the woodlot, the ease with which such a plantation lends itself to rational management, and the increasing interest in timber culture growing up among the farming classes all argue in favor of extensive commercial planting. If established on an economic basis and then properly handled, the farm forest plantation can be made to yield a net income equal to that which can be realized from agricultural crops.

The lack of intelligent care of the natural woodlot is responsible for its failure to be productive and remunerative. Mr Miller suggested the proper manner in which the forest plantation upon the farm should be handled to produce the best results.

GEOGRAPHIC NOTES

THE BALDWIN-ZIEGLER ARCTIC EXPEDITION

PRELIMINARY press reports and private dispatches give some indication of the outcome of the Arctic expedition led by Evelyn B. Baldwin and financed by William Ziegler. Perhaps the fullest account of the work, difficulties, and results of the expedition is that contained in the following telegrams:

REUTER'S AGENCY DISPATCH

This year's work has been successful. An enormous depot of condensed foods has been established by sledge on Rudolf Land within sight of the Italian Expedition's headquarters. A second depot has been formed in latitude 81° 33′, and a third depot at Kane Lodge, Greely Island, which has been newly charted as near the 81st degree of latitude. These large depots, together with the houses and stores left at Camp Ziegler, as well as provisions for the five ponies and 150 good dogs now on board, besides the pack itself, will afford means for a large Polar dash party next year. The fact that all the channels through Franz Josef Land remained blocked by ice during the autumn of 1901 prevented the establishment of depots by steamer last year. The breaking up of the ice early in June compelled us to use our reserve supply of coal, and hence our departure from Camp Ziegler on July 1 in order not to imperial the expedition. We dispatched 15 balloons with 300 messages in June. We have obtained the first moving pictures of Arctic life. We discovered Nansen's hut, recovering the original document left there, and securing paintings of the hut. We have also secured marine collections for the National Museum, new charts, etc. Thirty men, with 13 ponies, 170 dogs, and 60 sledges, were employed in fieldwork from January 21 to May 21, this severe work resulting in the destruction of the sledges. This and the depletion of the food for the ponies and the dogs rendered a return imperative.

ASSOCIATED PRESS DISPATCH

TROMSOE, NORWAY, *Sept. 4.*

The public has been deceived by false reports regarding the expedition. Nearly every member has been faithful, and my comrades ought and must have due credit for their work in establishing large depots at Camp Zeigler during March, April, and May. Sometimes they had to traverse the same route ten times. Fifty sleighs were destroyed in this work. Open sea near the depot at Teplitz Bay prevented us from reaching the Duke of Abruzzi's headquarters, and poor ice conditions in 1901 prevented us from establishing depots north of 80 degrees 22 minutes. In this connection the death of half our dogs necessitated the postponement of going to the Pole. Nothing favored returning *via* Greenland.

I believe the record of being farthest north could have been broken, but it would have exhausted our supplies and destroyed the hope of finally reaching the Pole.

Sailingmaster Johannsson's demands to become the America's captain were untenable and unbearable. His threat December 15 to take possession of the ship as captain and deal with the crew in accordance with his own will might have spoiled the expedition's plan if enforced. The ice pilot, as well as the first mate, who had long experience in polar ice, were entitled to recognition. Johannsson's refusal to obey the ice pilot's orders and his declared unwillingness to take the advice of my representatives on the sleigh expedition, together with other well-founded reasons stated to the American consul now here, caused his discharge and the promotion of three of his countrymen, who all followed me in the sleigh expedition and obeyed with pleasure the orders given by myself, my representatives, and the ice pilot.

BALDWIN.

AMERICAN ANTHROPOLOGICAL ASSOCIATION

A SPECIAL interest for anthropologists, and so for students of racial distribution, attached to the meeting of the American Association for the Advancement of Science this year at Pittsburg, June 30–July 3. A need long felt, but growing in intensity during recent years, found promise of satisfaction in the establishment of an association of anthropologists of national character. It was natural that the nucleus for such an association should be found in Section H of the American Association for the Advancement of Science, and the founding meeting was held on June 30 under the chairmanship of Dr Stewart Culin, Vice-President of this Section. This meeting resulted in the formal establishment of an association of anthropologists under the name of the American Anthropological Association. Later two executive sessions of the Association were held, and on Wednesday, July 2, there was a joint meeting of this Association with Section H, at which interesting scientific papers were presented and discussed. Prominent among those taking part in the discussions were William H. Holmes, Harlan I. Smith, J. Walter Fewkes, J. D. McGuire, and Walter Hough. The Association was represented in the Council of the American Association by Professor Holmes and Dr George A. Dorsey. The next regular meeting of the Association will be held at Washington in connection with the winter meeting of the American Association for the Advancement of Science, December 29 to January 3, 1903.

Although the invitations to the organizing meeting were sent to but forty working and teaching anthropologists, one of the most important actions taken at Pittsburg was that by which it was left open to other anthropologists who may be moved to do so during the remaining months of the year to affiliate themselves with the Association and be classed as Founders.

The officers elected were the following:

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F. W. Putnam, Vice-President for four years.

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W. H. Holmes, Vice-President for two years.

J. W. Powell, Vice-President for one year.

George A. Dorsey, Secretary.

Roland B. Dixon, Treasurer.

F. W. Hodge, Editor.

The Council includes the following persons: Frank Baker, Henry P. Bowditch, A. F. Chamberlain, Stewart Culin, Livingston Farrand, J. Walter Fewkes, Alice C. Fletcher, J. N. B. Hewitt, Walter Hough, Alés Hrdlicka, A. L. Kroeber, George Grant MacCurdy, O. T. Mason, Washington Matthews, J. D. McGuire, James Mooney, W. W. Newell, Frank Russell, M. H. Saville, Harlan I. Smith, Frederick Starr, John R. Swanton, Cyrus Thomas, and E. S. Wood.

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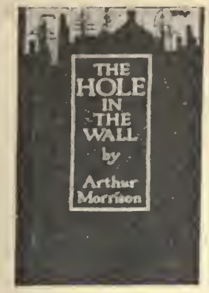

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Vol. XIII, No. 10 WASHINGTON October, 1902

THE NATIONAL GEOGRAPHIC MAGAZINE

OUR NORTHERN ROCKIES

By R. H. Chapman,

United States Geological Survey

If a line be drawn dividing the State of Montana about the middle of its east and west extent, the mountainous area will be to the west and the plains to the east of it. In the mountainous region the Government has reserved certain areas for the protection of the forests, and much of the region I shall describe lies within the Lewis and Clarke Timber Reserve.

The area of this reserve is about 6,000 square miles and covers both flanks of the Continental Divide, which here separates the waters of the Columbia and Missouri rivers, and so includes the main Rocky Mountain range. The major portion of it is mountainous, and lies between the Flathead Valley to the west and the great plain of the Missouri to the east, which stretches for a hundred miles, a sharp contrast to the ruggedness of the reserve. In these valley areas are towns, ranches, roads, and fences—marks of civilization. In the Reserve rough trails and a few Indian camp-grounds, marked by a number of "teepee" poles, are about the only culture features, although there are a few cabins.

It is our purpose in entering the reserve to visit prominent mountain peaks to build cairns or signals of timber on their summits, to make the necessary observations to enable us to locate by triangulation these signals, and to compute the latitude and longitude, distance and directions, from other known points. These signals are to be used by the topographers in mapping the reserve.

It is also necessary to make sketches of the route traveled, the existence and condition of trails and camping places, to make note of burned areas, and to get as much general information as possible of this wild region.

I shall ask you to imagine yourselves making a journey with me on horseback, our limited baggage and many weeks' supplies packed on the backs of mules. To such places as we cannot ride and drive our train, we will take our loads upon our own backs and travel on foot. We will pass through the Flathead Valley, take a course approximately northeast until, passing the many ranges which make up the Rocky Mountain backbone, we emerge upon the plain of the Missouri River.

Flathead Valley. Mission Range in background

The Flathead Valley is of considerable area—open, grassy, and rolling, dotted by ponds and lakes, the largest being Flathead Lake, which is about 30 miles long, 5 to 12 miles wide, and about 2,900 feet above the sea.

This region is one of the best in the state for raising grains and the hardier fruits; it requires little or no irrigation, as there is an abundant rainfall. It is largely within the Flathead Indian Reservation, through which we pass en route to the mountains beyond. The Indians, gathering from all directions to celebrate the holiday of the Fourth of July in dancing and horse-racing, call to us to stay and pitch our tents in the circle and "have some fun;" but on we go, the mountains to the west and south—rolling and beautiful—straight up the narrowing canyon toward the Mission Range, which rises to the east, directly in front of us. Here are blossoms and grass in profusion, stately trees, and grateful shade.

The summits of the Mission Range gradually increase in height toward the south and culminate in McDonald Peak, which is about 10,000 feet above the sea. This peak wears perennial snow, has several glacial remnants, and is difficult of ascent late in the season after heavy snows. The peak is one of the triangulation stations of the Geological Survey, and I have attempted to climb it on four occasions, the first and the last being successful. The unsuccessful attempts were made in October and November; the successful ones in July and August.

As we ascend we cross many snow-banks, and eventually make our camp high in the range at the most available spot, where there is only five feet of snow—a sharp contrast to the valley behind us. Our horses and mules are fed a few handfuls of grain—"to keep them cheerful," as the packer says—and we start for the pass and peak (McDonald) by the easiest route, a wearying one at best. We skirt the cliffs, have superb views on every hand, the problem always in front of us white and forbidding. After many hours of steady but not dangerous climbing, we at last stand on the summit, gazing from the midst of winter to the sunny plains of summer, miles away and thousands of feet below. We are wet to the skin, and the wind penetrates all the clothing we can wear, so that the return is begun as soon as possible.

The weary climbing through heavy snow is replaced by long, exhilarating slides down the hard slopes, the spike of the alpenstock scratching a deep track in the snow and our knees aching with the long tension, and at nightfall we reach camp, to find that every gunny-sack, many saddle blankets, and the front of my waterproof coat have all been eaten by the hungry mules.

The Mission Range is the westernmost of the several ranges which collectively represent the Rocky Mountains, and it receives more rain and snow than the ridges to the eastward, being the first to intercept the moisture-laden winds from the southwest. The range is much steeper on the western slope than on the eastern, which is accounted for by the geologic structure; but at the top of the ridge so much glacial erosion has taken place, so many amphitheaters and deep gorges have been cut, that the crest is broken into a number of isolated peaks.

We find it is made up of a series of limestones, which dip to the northeast, with some quartzite and intrusions of igneous rock, the west face being a fault plane. The stratification and dip of the beds are clearly shown in the view on page 371. This may be taken as a type of the ranges west of the Continental Divide.

To the east of the Mission Range lies Swan Valley, extending some 55 miles north and south and being about 10 miles wide. It is drained by Swan River, which heads in the snow and ice fields of the Sin-yel-a-min Peak and Jocko Crags and flows northward for a time in a narrow, ice-cut gorge, now

"We start for the pass and peak (McDonald) by the easiest route"

McDonald Peak from East. Lace Lake in Foreground occupied by Long or Elbow Lake, then through a wide, gently graded valley to Swan Lake, which in turn empties into the Flathead River. This valley is flat and U-shaped, has many ponds and small lakes, and is densely timbered, with many small "parks," grassy and beautiful. Several days are consumed in making the descent to, and crossing the Swan Valley, as it is difficult to accomplish in an east and west direction. The timber and trails are in many places choked by wind-fallen trees, and our animals are jumping these logs, their legs scraped and bruised; but they are well fed, as grass of the best quality is found in many open meadows. The river, flowing over gravels and sand, abounds in fish, and we feel that we are in a camper's paradise.

The range to the east of this valley is the Swan Range. It is the highest and least broken ridge in the region, the higher peaks rising to ten and eleven thousand feet. It extends from the south line of the reserve to a point northeast of Kalispell, where it is cut by the Flathead River in a gorge named "Badrock Canyon," and through which the Great Northern Railway passes.

Like the Mission Range, the Swan is steeper on the west slope. The rocks dip to the northeast, and are folded and fractured on a large scale, and superb views are constantly coming before us. Our trail up this slope is plain, but steep and hard, and when the pass is reached we are four thousand feet above the valley. Stunted pines and scanty grass surround us here, lakelets dot the bottoms of the narrow gorges, and the mighty peaks rise far above us. To reach these peaks we find that the route to travel is along the ridge. The cliffs are about 1,000 feet high. We remember that while trying to reach the Holland Peak in 1900 this ridge was so covered with glare ice as to be impracticable; a long detour was necessary and the total climb of about 8,000 feet so wearying, that one man collapsed as we returned in the darkness. We could not leave him to sleep with no awakening, in the snow, so rolled him in canvas, fastened ropes to his feet and shoulders, and tobogganed him down 2,000 feet to a frozen camp.

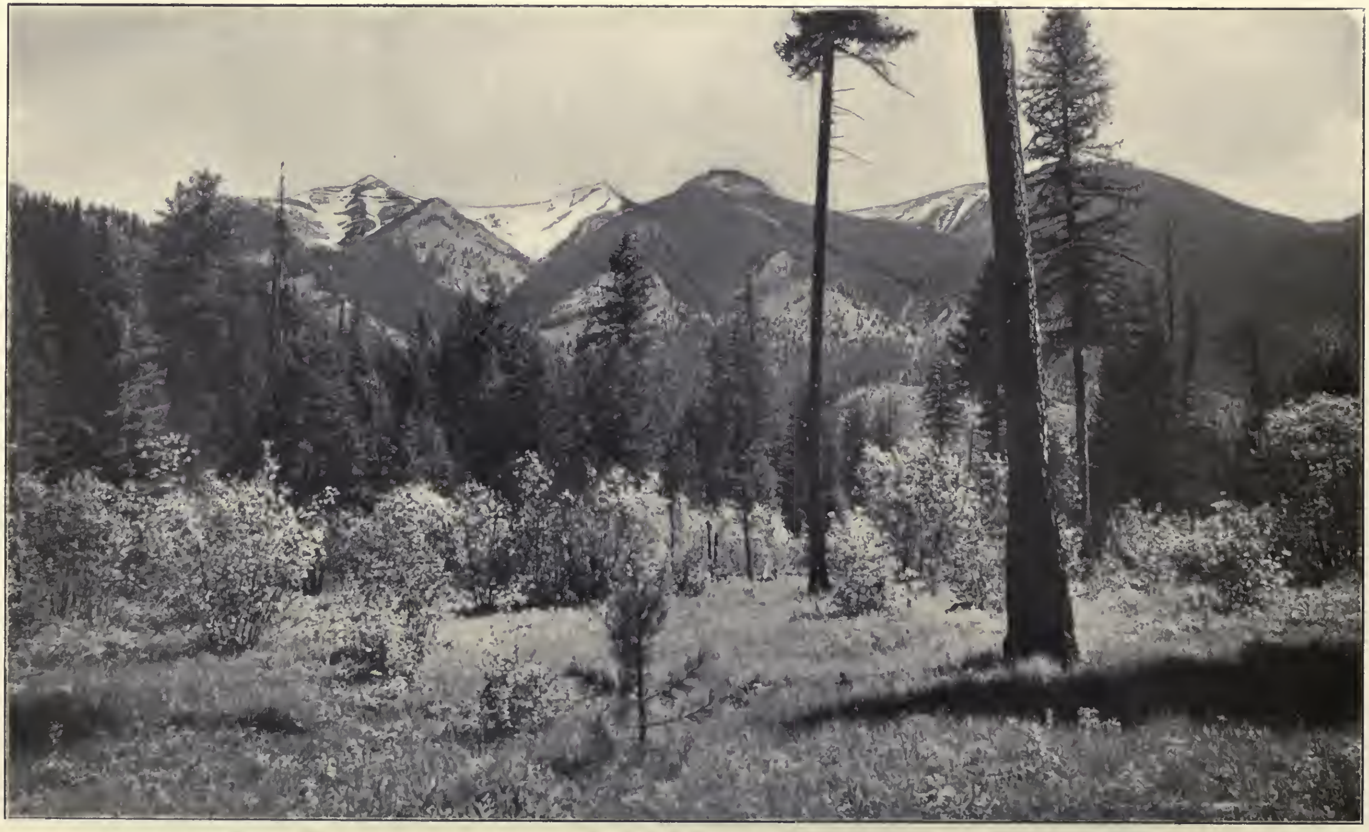
The eastern slope of the Swan Range we find to be in the nature of a benchland cut deeply by gorges and canyons eroded by local glaciers, of which only the remnants remain.

The Swan Peak is the highest of the range (about 11,000 feet), and the largest ice mass of this range flanks it.

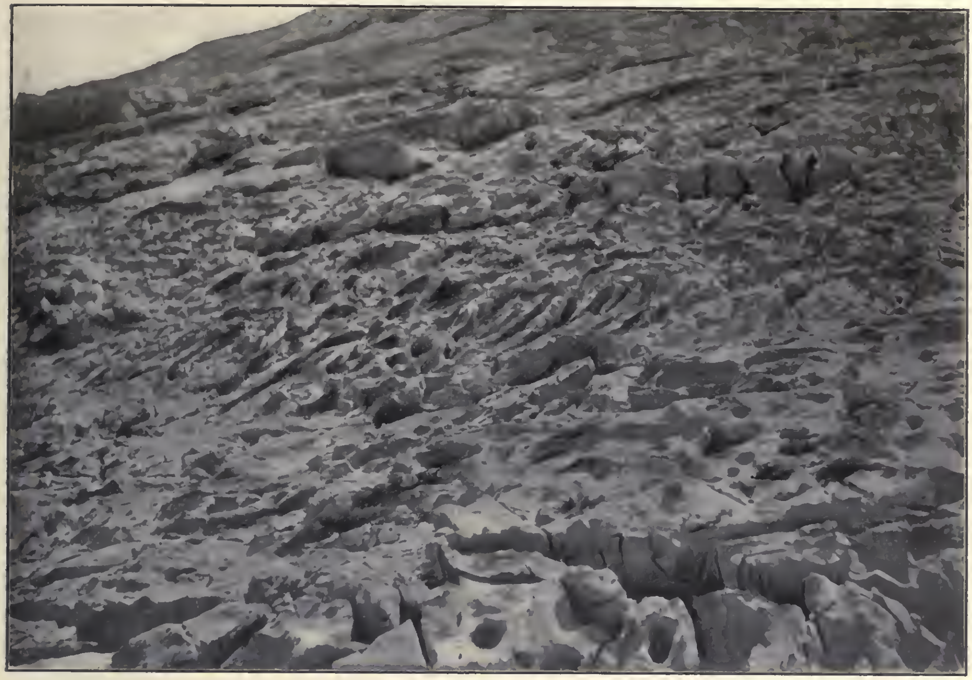
The Swan Ridge is the western rim of a large basin drained by the South Fork of Flathead River, and the descent to the valley is long and rough and the trails much choked by fallen timber. Our route is across the shelf lying between the crest ridge and the final steep slope of the valley proper, which is heavily timbered. There is a trail the whole distance from the head to the mouth of the South Fork, but no novice must attempt to follow it.

At a point east of the Holland Peak the valley of the South Fork of Flathead is broad, flat-bottomed, and covered with fine, open timber and with grass, and at this point our trail follows the river bottom or ascends to the slopes of the gravel deposits flanking it. Here we find evidence that the indomitable prospector in his quest for wealth has anticipated our arrival. His cabin is decaying and his tunnel-mouth caving in, and we find that coal is his ambition, from the nature of the material on the river bank.

Many miles below, where the stream crosses several limestone ridges, it runs in a sharp "box" canyon, and the trail, which follows the canyon brink quite closely, is difficult and dangerous; it is sometimes *in* the water and at others eight or nine hundred feet *above* it. It is often a great problem to get animals across the canyons in which the



Mission Range. Sin-yel-a-min Peak from high Park South



Erosion of Limestone near Silvertip Peak

"A pavement not calculated to increase our rate of travel many miles per day"

side streams join the main river, and to cross the river in these canyon districts is impossible. When the water is high, traveling in this valley is out of the question. At one point the whole river, when at low stages, flows in two channels, each not more than five or six feet wide, which may be crossed dry shod by springing over them, though the water is 50 feet or more in depth.

Unlike the Swan River, the South Fork is doing much work in cutting a way through the limestones and shales which it encounters, the canyons being picturesque in the extreme.

The ridge next to be scaled to the east of the South Fork is the Continental Divide—the watershed of the Rockies, which is flanked by numerous spurs or parallel "rampart" ridges, shown in the views taken from the Silvertip Peak. This peak we have found to be easily climbed, the pack-mule carrying instruments to within 500 feet of the top. It is a huge mass of limestone on top of a plateau guarded by long lines of cliff, with sentinel peaks at every approach. The plateau is almost devoid of vegetation, the surface being worn into innumerable channels by the waters running from huge snow banks, a pavement not calculated to increase our rate of travel many miles per day.

Upon reaching the summit of the Divide we discover that the cliffs which we have continuously scaled or circled. and which face southwest, are replaced by similar ones facing northeast, so that our difficulties, which have been of *as*cent, become ones of *de*scent, and may in many places be accomplished with no effort, little fun, and less comfort, unless great care be taken. Continuing in our northeasterly course, we reach the headwaters of the River of the Sun by a rough trail—great peaks, now of limestone, light yellow, buff, or bluish in color, and again of shales, red, green, and slate color, on every hand. The Sun River was named by the Indians, some say on account of the brilliance of the light, due to reflections from the many cliff walls in the upper reaches and from the open, light-buff-colored plain east of the mountains. It was long used as a gathering point for the tribes east of all the ranges for the "sun dance." It might well be named for Æolus, as its canyon serves as a funnel through which all the "winds of heaven" rush forever.

In the valley of Sun River are numerous hot springs and *deposits* of springs long since extinct. The Indians use the waters of these springs for drinking and bathing to cure many ailments, and today the location is one frequently visited by camping parties from the valley towns.

The Sawtooth, or Sun River Range, divides the upper branches of Sun River from the Missouri plain, and is the east front of the Rockies. The rocks of this range are largely light-colored limestones, and are faulted and eroded into a series of ragged, sharp peaks rising abruptly, and are very impressive.

From the divide until the open plain is reached the Sun River crosses no less than twelve ridges, usually of limestone (but sometimes igneous rocks), and cuts a canyon through each, similar to

Continental Divide. East Face of Cliff near Silvertop Peak

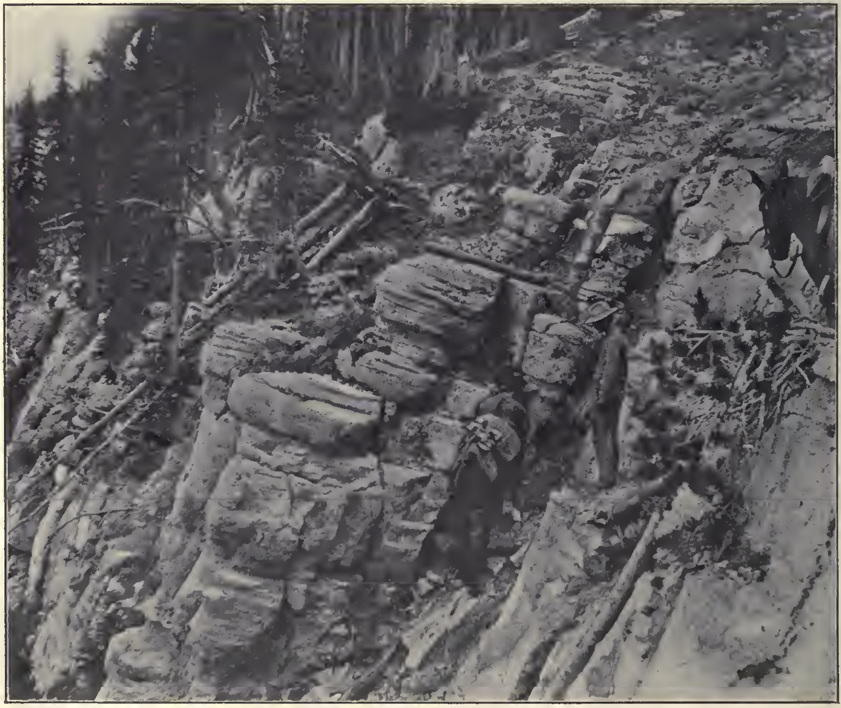
Continental Divide—Pentagon Peak (Limestone)

those described in the valley of the South Fork of Flathead.

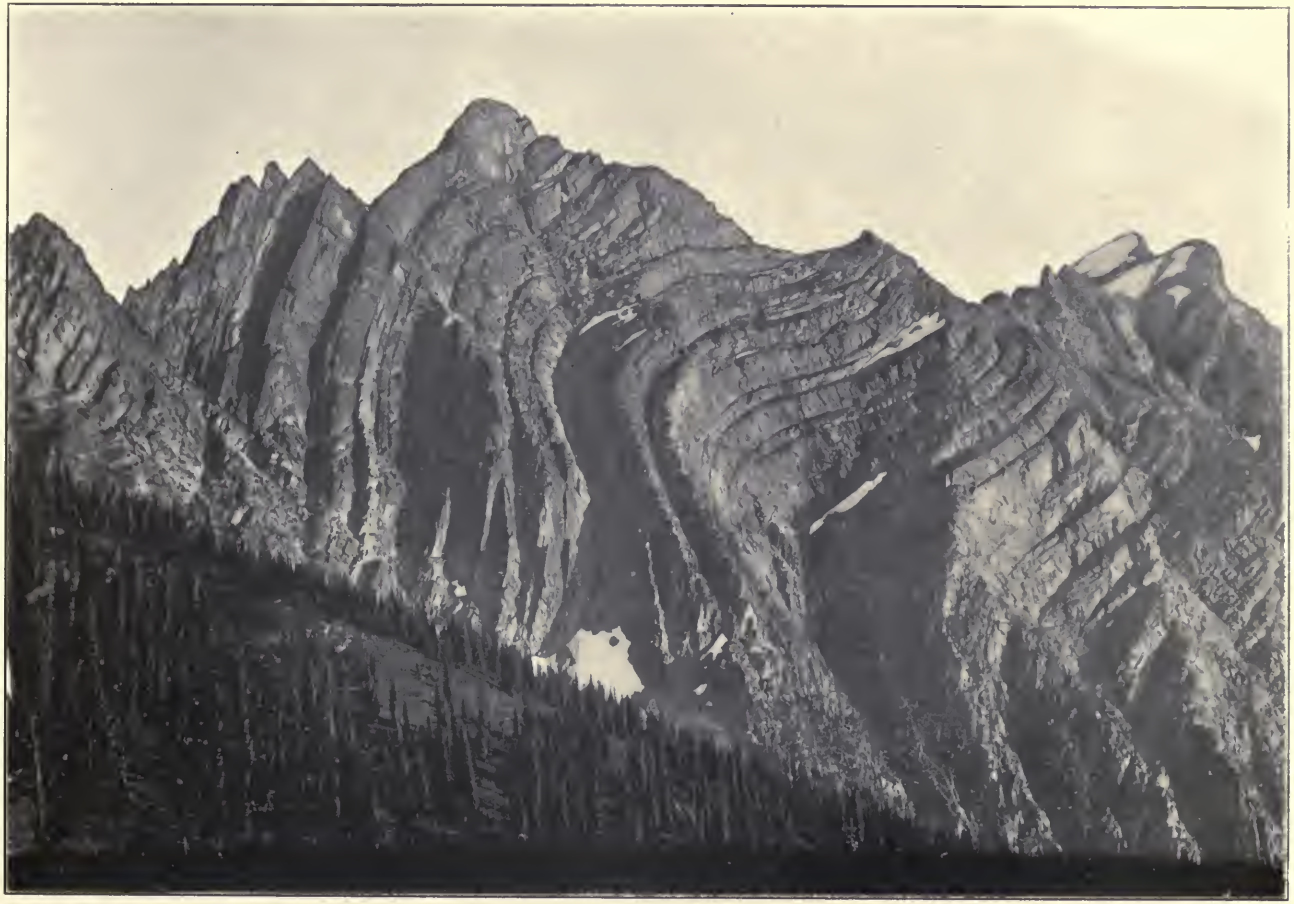
The abruptness of the ranges to the east of the Divide and the lines of continuous cliff, make the trails across them steep, slippery and dangerous, and detours of many miles are often necessary in order to cross some unbroken line of cliff. We find a trail which we built as long ago as '97, since used only by elk and deer, and which is still in condition to use; and at last the pack animals are safely over it. During our journey we have found many difficulties—cliffs and canyons in the mountains, and in the valleys the problem has been to make our way through dense forest growths, often complicated by large areas of wind-fallen timber and sometimes by swampy ground, or all three of these conditions at the same time, when the problem has been well-nigh disheartening. We are sometimes confronted with the débris of a snowslide, which makes no small delay in our progress toward the objective point. We have found large areas that have been burned over by forest fires, which transform live, cool forests into desolate tangles of dead trunks, and we have passed through fires, smouldering, which would have become a raging conflagration with the advent of a heavy wind, a by-no-means uncommon thing in the mountain districts. These fires are often started by Indians, out hunting, who build smudges to protect their horses from the big flies and mosquitoes, and so prevent the animals from stampeding. These insects are a terrible affliction to both men and beasts, and are omnipresent in the valleys during July and August.

We have found that the weather condition at any given time is of no small importance in endeavoring to prosecute work in this region. In the mountains snow may fall at any time; July and August are by no means exempt from snow squalls, and September will always bring a storm. New snow, whether falling or lying, will always be no small factor in the difficulties attending a climb. In October, 1900, the party made three attempts to reach the summit of the "G. N." Peak. The third was successful, but during the second attempt slides of no mean proportions passed, one a few yards ahead and one but a few, behind the party. These slides were of the newly fallen snow, and passed over smooth rock surfaces with a comparatively slow motion, the front of the moving mass turning under as the breakers do on the beach at the seashore; the sound was a "shush" of low tone but goodly volume. If caught by one of these a man would be rolled over and under and inevitably smothered.

But the time has come when provisions are exhausted, and the leader of the pack-train is turned toward the nearest accessible point of supplies. At the first cabin—a halfbreed's—we obtain a little tobacco and flour, enough to carry us to the store. The mountains are slowly left behind us, and low ridges, much scarred by forest fires, the usual accompaniment of approaching civilization, give way in turn to the grassy hills and finally to the open plain,



Pack Train Crossing Limestone Cliff on Trail Built of Green Timber



Folded Strata Just South Heaves Peak. From Snow Bank to Summit is about 2,000 Feet

Missouri River Plains and Pack Train

"The mountains are slowly left behind us . . . and our eyes, so accustomed to crags and peaks, look upon an apparently boundless prairie, blazing hot, dusty, and shadowless"

where our eyes, so accustomed to the crags and peaks and such limited horizons, look upon an apparently boundless prairie—blazing hot, dusty, and shadowless; but with letters and news of the world's doings at the post-office.

The fascination which is born of exploration and travel in a great mountain region never quite leaves one, and the northern Rockies are a field worthy of any man's study. The diversity of the demands upon him, the inspiring scale upon which his surroundings are builded, make human accomplishment seem, in a measure, vain; but there are obstacles to be overcome, requiring all his attention and effort; streams to be forded, glaciers to pass, cliffs to be scaled, and mighty walls, measured by thousands of feet, tempting him to greater efforts, fitting monuments if he fails.

LIMITING WIDTH OF MEANDER BELTS

By Prof. Mark S. W. Jefferson,

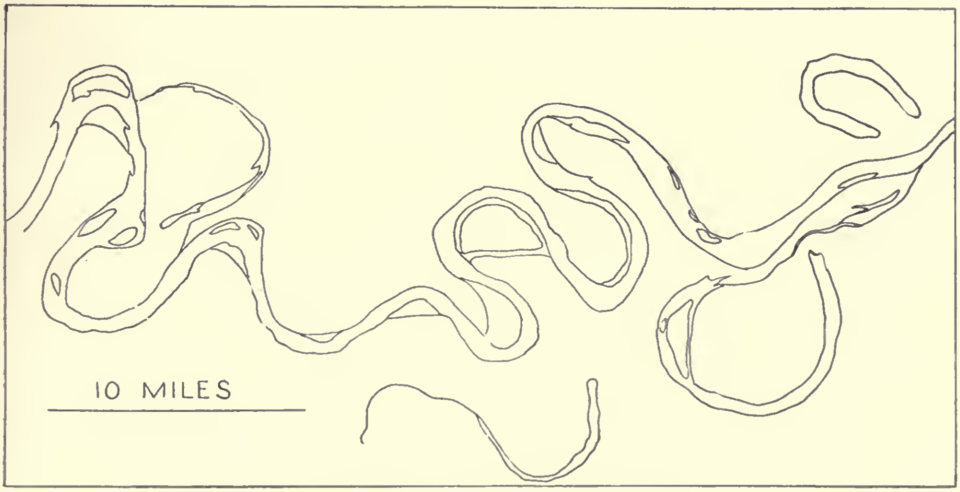
State Normal College, Ypsilanti, Michigan

> "One of the most characteristic features of streams, whether large or small, is the tendency to wind in serpentine curves when the angle of declivity is low, and the general surface of the country tolerably level."—*Seikie: Text Book of Geology, 3d ed., p 387.*
>
> "The Meander, a serpentine river of Asiatic Turkey, has given its name to this river habit. . . . The size of the meanders increases with the volume of the stream. A meadow brook may swing around curves measuring only 40 or 50 feet across. The curves of the lower Mississippi are from 3 to 6 miles across."—*Davis: Physical Geography, pp. 243-244.*

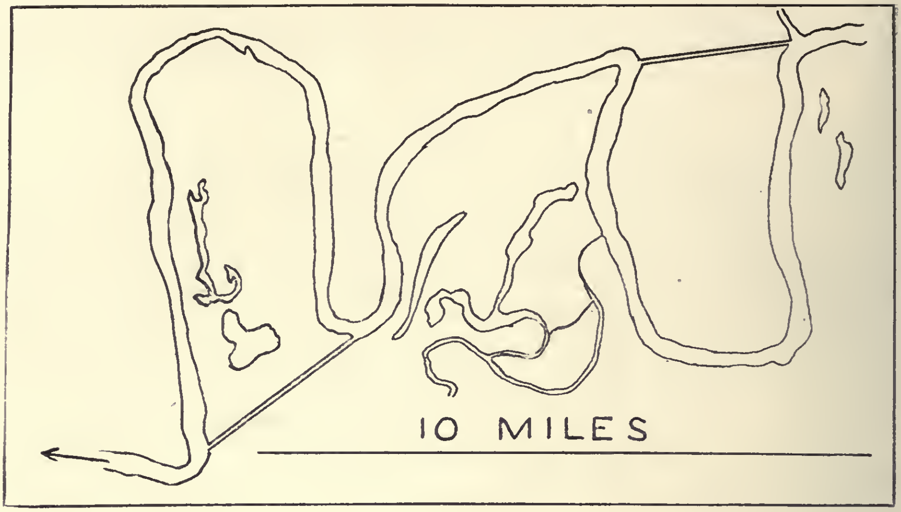
THE present paper seeks to establish a limit for the width of the belt of meanders of any given stream and finds that limit to be eighteen times the mean width of the stream at the place, the depth of water and the volume of stream discharge being negligible in the present state of geographic knowledge.

If we examine the course of any well-mapped meandering river, as the Mississippi at Greenville, Miss., we shall observe that it is very irregular.

Stretches of wide-swinging meanders alternate with stretches of wavering course, where the river trends along a straight line, but with tremulous leanings to one side or the other. These wavering stretches are further embarrassed by sand bars and islands flung into the river's path in disorder. The meandering stretches are distinguished by a more positive, self-assertive character, the sand bars are pushed mostly to the inner bank, while the channel hugs the outer at each curve. But here, too, is a certain hesitancy in the sweep of lines, suggestive of numerous factors of control. Even disregarding these minor waverings, the meanders display great variety of type and dimension within short distances. Along the Mississippi may be observed circles of differing radius, ovals and ellipses distorted



The Mississippi at Greenville



The Theiss, Basin of Hungary

in every conceivable direction with respect to their own axes and the trend of the river. Certainly there is great diversity, even appearance of disorder, here.

But when the processes that are changing geographic forms are studied, system and law become at once more evident; not that the process is more systematic or observant of law than the resultant forms, but only a mind conscious of process can perceive the systematic element in the forms. At every bend is the stream-cut bluff without and growing sand bar within. Along each wavering stretch lie the oxbow lakes and sloughs to right and left. Everywhere are seen signs that the river, wandering too far to right and left in its meandering stretches, recovers itself by cutting off loops it has planned beyond its powers, to again stagger aimlessly, gathering momentum across its valley as its thread rebounds from bank to bank and presently begins meandering anew.

To measure the width of the belt of meanders between lines tangent along the swings of the river to right and left is to measure a varying quantity that finds its minimum in wavering reaches and its maximum in some strong group of meanders. This value must be selected as characteristic of the river, since the river's swinging tendency finds in it its fullest expression.

There are many difficulties in the measurement of meander belts. In practice, judgment is aided by the presence of cut-off loops and by the empirically determined fact that streams rarely attain their maximum width of meander until the belt is two or three times as wide as the successive loops are distant along the general course of the river. This ratio is given for the rivers for which data are tabulated at pages 378 and 379 under the heading $\frac{mb}{d}$, or meander belt divided by distance. It gives an excellent idea of the stage of development of any system of meanders.

WHY VOLUME IS NEGLECTED

We have very little accurate knowledge of stream discharge to obtain good data for the rivers that are otherwise suitable for meander study.

The following is a brief outline of method and result of an attempt in this direction. Three streams were first considered as having mature meanders on flood plains of very slight inclination. They were the tiny Matfield at Elmwood, Mass., the moderate Oder at Kosel, Silesia, and the giant Mississippi at Greenville.

The Matfield was carefully mapped for this purpose.

Essential quantities, such as the meander belt, were measured directly on the ground. As run-off could only be determined by observations through a long series of years, I thought it better to utilize the results already obtained by 36 and 19 years respectively of observations in the neighboring Mystic Lake and Lake Cochichuate watersheds. I obtained the results from Water Supply and Irrigation Paper No. 35, page 39, that on those basins the run-off was respectively 1.49 and 1.46 cubic feet of water per second for every square mile of surface. As the Matfield basin above Elmwood Village bridge has an area of about 43.5 square miles, making allowance for the water diverted to the use of the city of Brockton, I estimate its run-off at an average of 63 cubic feet per second. The meander belt is about 450 feet wide.

For the Oder we learn from Der Oderstrom, Berlin, 1896, map 11, that there is a typical recent cut-off at Kosel. The meander belt is 4,688 feet wide. The same work puts the Oder's discharge for mean stages, with the Kosel gage reading 1.29 meters, at 1,907 cubic feet per second. According to a table by Loeschmann, Beiträge zur Hydrographie der oberen Oder, page 55, this corresponds to an average annual flow of 2,407 cubic feet per second. This is probably too small a quantity, as the volume discharged at high stages must have a far greater departure from the mean than that at low stages.

The Mississippi data are from Park Morrill's Floods of the Mississippi River, Report of the Chief of the Weather Bureau, 1896–'7, page 391 and plate IV. Adding the drainage of the upper Mississippi, Ohio, Missouri, and Arkansas basins to A, B, C, and ⅔ D in the Central Valley, I estimate the discharge at Greenville at 570,000 cubic feet per second. From sheet 14 of the preliminary map of the lower Mississippi it appears that the meander belt attains a maximum width of 55,000 feet at that point.

Since the doubtful data for these streams was all I had access to for maturely meandering streams, I looked for what confirmation might be had from various rivers not on typical flood plains, but flowing in inherited meanders now incised in the region of Appalachian and Alleghany uplifts. I found run-off estimates for these streams in F. H. Newell's Hydrographic work, Nineteenth and Twentieth Reports of the Director of the U. S. Geological Survey, section Hydrography. Meander belts were measured on the topographic maps of the Geological Survey.

To show the departure of these streams from the flood-plain type the feet of descent per mile have been included in the table in the column headed *f*; *mb* heads that containing widths of meander belts in feet, while *md* heads the column of discharges in cubic feet per second.

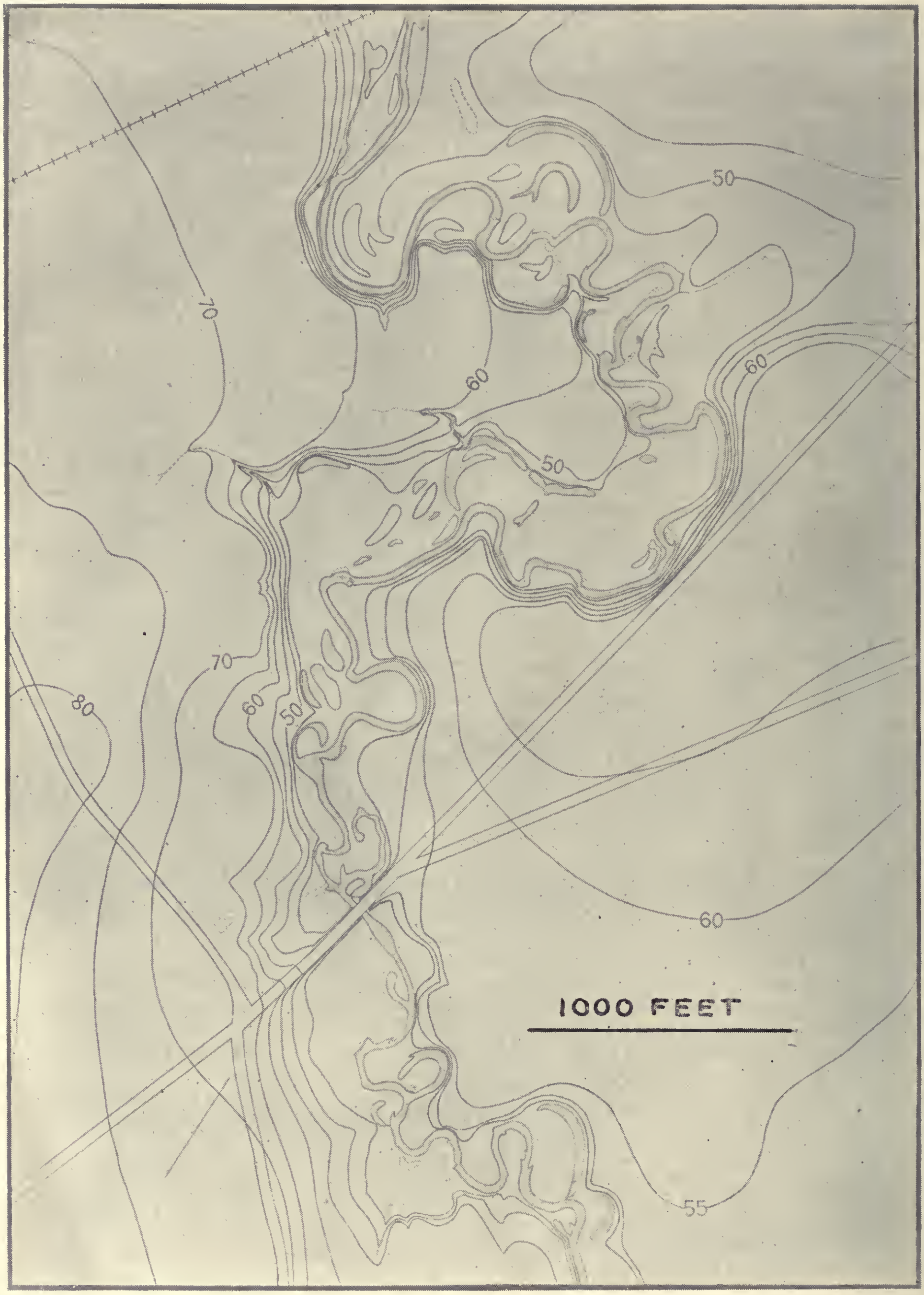
A—ON FLOOD PLAINS

	f	*mb*	*md*	
Matfield	......	450	63	Elmwood, Mass.
Oder	...	4,688	2,407	Kosel, Silesia.
Mississippi	......	55,000	570,000	Greenville, Miss.

B—INCISED

Etowah	6.4	4,000	1,134	Canton, Ga.
James	7	8,448	1,779	Buchanan, Va.
Greenbrier	7	9,768	2,080	Alderson, W. Va.
Shenandoah	3	9,000	2,700	Near Potomac River
Tennessee	*	26,400	40,000	Chattanooga, Tenn.

* Less than a foot.



The Matfield at Elmwood, Mass.

Calling the Tennessee comparable to the first three rivers because of its moderate descent, we may construct a curve with discharges for ordinates and meander belts for abscissas. The curve is, however, determined at points too few and badly placed to be of much value. The following selected quantities indicate well enough its character :

md	*mb*
0	0
500	1,400
1,000	2,600
5,000	7,000
10,000	10,700
50,000	28,000
100,000	33,500
500,000	54,000

That is, the larger the volume of water discharged by a river, the wider its meander belt, but the *differences* in width are less as the rivers are greater in volume.

The data for incised rivers do not fall into this curve. Such data do not suffice to establish definite relations.

SOME THEORETICAL CONSIDERATIONS

Stream volume is a function of width, depth, and velocity. Maturely meandering streams may be regarded as finding their slope too steep. As this gave them more energy than was needed to carry their load of waste seaward, they employed the excess in cutting sidewise, forming meanders until their slope was thus lengthened and flattened to their taste. The Mississippi travels 80 miles along its winding channel in flowing from Greenville to a point 45 miles due south. In so doing it reduces its descent from 7 inches to 4 inches per mile. When a cut-off thwarts further lengthening of the course, we must suppose that the proper slope has been already reached. So maturely meandering streams will have courses tending to a minimum of inclination, differing with each other chiefly as they carry more or less silt. It is probable that meander-cutting, like all other erosive work, is chiefly effected at recurrent moments of more intense activity. Perhaps there is never a cessation of the cutting on the outer bluff ; yet the greater part of the work will be done at times of swollen waters. At these moments the streams are burdened with silt to their utmost capacity, all of them alike and each of them in its mean thread of flow. The swift outer reaches are still eager to take more earth from the bank, while every check within a bend is the scene of active deposition. As the load of silt determines the slope needed for its transportation, here is another agency tending to uniformity of slope in all streams with well-developed meander systems. These considerations look to the elimination of velocity as a constant factor in the volume of the stream ; there remain as varying factors width and depth.

We cannot assert that at the time of most effective meander-making depth, too, is a constant, but there are considerations which tend to show it has little effect on the width of meander belts.

The width of a meander belt depends immediately upon the sharpness with which a stream can turn a corner. Generally speaking, the longer the radius of curvature, the wider the belt, and the shorter the radius, the narrower the belt. The stream's difficulties in turning increase with the stream's width quite apart from its depth.

Material cords and cables offer some interesting analogies. A thread may be doubled sharply on itself, a string less sharply, while a large rope or cable can only be bent in a wide, open turn. The difficulty is with the inside strands. The thicker the rope, the more there are of them, and the more they insist on taking up room and holding the bend open. If a board is to be bent sidewise, an in-

TABLE A.

River.	Scale.	*mb*	*w*	$\frac{mb}{w}$	$\frac{mb}{d}$	Place.	Map.
1. *Mississippi	$\frac{1}{63360}$	55,000	2,830	**19.4**	3.2	Greenville, Miss.	Sheet 14, preliminary map.
2. *Matfield	$\frac{1}{1200}$	450	30	**15.0**	2.6	Elmwood, Mass.	Abington, Mass , and p. 376.
3. *Oder	$\frac{1}{25000}$	4,688	243	**19.3**	2.2	Kosel, Silesia	Der Oderstrom, Karte 11.
4. Oder	$\frac{1}{50000}$	8,335	416	**20.0**	....	Breslau, Silesia	Der Oderstrom.
5. *Rhine	$\frac{1}{100000}$	22,925	1,250	**18.3**	3.5	Above Worms	Der Rheinstrom, Karte 13.
6. *Rhine	$\frac{1}{100000}$	16,667	787	**21.2**	2.6	Above Speyer	Der Rheinstrom, Karte 13.
7. Yssel	$\frac{1}{50000}$	8,963	417	**21.5**	1.4	Doesburg, Holland.	Arnhem, 40.
8. Meuse	$\frac{1}{50000}$	13,702	625	**22.0**	3.2	Megen, Holland	Rhenen, 39.
9. *Danube	$\frac{1}{200000}$	25,680	1,389	**18.0**	4.0	Latitude 46° 27′	37° 46°, Maria Theresiopel.
10. *Meuse	$\frac{1}{50000}$	7,292	382	**18.1**	2.5	Latitude 51° 10′	Roermond, 58.
11. *Dniester	$\frac{1}{200000}$	6,944	422	**16.4**	3.0	At mouth	48° 46°, Odessa.
12. *Dniester	$\frac{1}{200000}$	5,555	389	**14.3**	3.5	Latitude 49° 20′	42° 49°, Stanislau.
13. *Theiss	$\frac{1}{200000}$	18,611	694	**27.0**	2.5	Latitude 46° 57′	38° 47°, Szolnok.
14. *Gardon	$\frac{1}{80000}$	6,780	422	**16.0**	(?)	Latitude 43° 51′	État-Major, 222.
15. Save	$\frac{1}{200000}$	12,840	833	**15.4**	2.3	Latitude 45° 5′	36° 45°, Brod.
16. *Drau	$\frac{1}{200000}$	9,360	833	**11.5**	2.5	Latitude 46° 0′	35° 46°, Bellovar.
17. *Urbas	$\frac{1}{200000}$	4,280	278	**15.4**	4.0	Latitude 45° 2′	35° 45°, Banjaluka.
18. Una	$\frac{1}{200000}$	7,487	555	**13.5**	3.6	Latitude 45° 15′	35° 45°, Banjaluka.
19. Tagliamento	$\frac{1}{200000}$	7,487	361	**20.8**	3.0	Latitude 45° 44′	31° 46°, Trieste.
20. Panaro	$\frac{1}{75000}$	3,100	188	**16.5**	3.3	Latitude 44° 37′	Bologna, 87.
21. *Carron	$\frac{1}{63360}$	2,006	132	**15.2**	2.3	Latitude 56° 1′	Ordnance survey, Scotland, 39.
22. *Theiss	$\frac{1}{200000}$	11,250	625	**18.0**	2.2	Latitude 46° 25′	Kistelek und Szegedin.
23. Mississippi	$\frac{1}{316800}$	31,680	2,640	**12.0**	2.7	South of Baton Rouge	4-sheet map, Lower Mississippi.

TABLE B.

River.	Scale.	mb	w	$\frac{mb}{w}$	$\frac{mb}{d}$	Place.	Map.
1. Tallapoosa	$\frac{1}{125000}$	6,600	400	**16.5**	2.3	Latitude 33° 40′	Tallapoosa, Ga.
2 Tallapoosa	$\frac{1}{125000}$	9,360	520	**18.0**	2.0	Latitude 33° 15′	Ashland, Ala.
3. Coosa.	$\frac{1}{125000}$	13,200	750	**17.6**	2.4	Latitude 33° 40′	Springville, Ala.
4. Locust Fork	$\frac{1}{125000}$	8,580	330	**26.0**	2.0	Latitude 33° 50′	Birmingham, Ala.
5. Locust Fork	$\frac{1}{125000}$	10,000	400	**25.0**	2.5	Latitude 33° 35′	Jasper, Ala.
6. French Broad	$\frac{1}{125000}$	25,080	990	**25.0**	1.6	Latitude 36° 5′	Morristown, Tenn.
7. French Broad	$\frac{1}{125000}$	13,200	850	**15.5**	2.0	Latitude 35° 55′	Knoxville, Tenn.
8. Nolichucky	$\frac{1}{125000}$	15,180	600	**25.0**	1.7	Latitude 36° 10′	Morristown, Tenn.
9. Tennessee.	$\frac{1}{125000}$	19,800	1,000	**19.8**	2.0	Latitude 35° 45′	London, Tenn.
10. Tennessee.	$\frac{1}{125000}$	26,400	1,400	**19.0**	1.2	Latitude 35° 5′	Chattanooga, Tenn.
11. Hiwassee.	$\frac{1}{125000}$	13,200	660	**20.0**	1.7	Latitude 35° 10′	Murphy, Tenn.
12. Cumberland	$\frac{1}{125000}$	10,000	500	**20.0**	2.8	Latitude 36° 50′	Cumberland Gap, Ky.
13. Cumberland	$\frac{1}{125000}$	9,900	330	**30.0**	1.4	Latitude 36° 45′	Williamsburg, Ky.
14. Powell	$\frac{1}{125000}$	11,220	600	**18.7**	3.0	Latitude 36° 33′	Cumberland Gap, Ky.
15. Red River	$\frac{1}{125000}$	13,200	400	**33.0**	2.3	Latitude 37° 50′	Beattyville, Ky.
16. Kentucky	$\frac{1}{125000}$	20,340	550	**18.5**	3.0	Latitude 37° 40′	Beattyville, Ky.
17. Connasauga	$\frac{1}{125000}$	18,480	450	**41.1**	3.0	Latitude 34° 40′	Dalton, Ga.
18. Colorado	$\frac{1}{250000}$	20,000	1,000	**20.0**	3.0	Latitude 38° 35′	La Sal and San Rafael, Utah.
19. Colorado	$\frac{1}{250000}$	21,000	600	**35.0**	2.5	Latitude 37° 0′	Escalante, Utah.
20. New	$\frac{1}{125000}$	18,000	700	**25.7**	3.0	Latitude 37° 10′	Dublin, Va.
21. Dniester	$\frac{1}{200000}$	23,611	694	**34.0**	2.2	Latitude 48° 52′	43° 49°, Kolomea.
22. Dniester	$\frac{1}{200000}$	40,000	1,111	**36.0**	2.2	Latitude 48° 3′	46° 48°, Soroki.
23. Marne	$\frac{1}{80000}$	17,190	255	**67.0**	3.3	Latitude 48° 48′	État-Major, 48.
24. Seine	$\frac{1}{80000}$	47,110	1,067	**44.0**	2.5	Near the mouth	État-Major, 30.
25. Seine	$\frac{1}{80000}$	51,000	600	**85.0**	3.5	Near Paris	État-Major, 48.
26. Seine	$\frac{1}{80000}$	29,535	933	**31.7**	2.0	Between Paris and sea	N. E., État-Major, 47.
27. Oise	$\frac{1}{80000}$	13,333	267	**49.9**	(?)	Latitude 49° 1′	N. O., État-Major, 48.
28. Agout.	$\frac{1}{80000}$	11,067	167	**66.3**	1.8	Latitude 43° 43′	N. E., État-Major, 230.
29. Tarn	$\frac{1}{80000}$	9,533	467	**20.4**	1.7	Latitude 44° 6′	S. O., État-Major, 206.
30. Waag	$\frac{1}{75000}$	5,625	375	**15.0**	2.0	Latitude 49° 10′	Rosenburg u. Rutka.

crease in the width is a greater hindrance to bending than an increase in the thickness in the proportion of the square of the increment, doubled width being four times as effective for resistance as doubled depth.

Strictly, in the case of the turning river, it is a matter of momentum. Could we have a single thread of water flowing along a curved or crooked channel, its turns would be made with ease, however sharp; but actual streams are always made of many threads of water side by side, and when the outer thread seeks to rebound from the outer bank at a turn, the momentum of the inner threads drives it along in a course that is kept straighter in proportion as there are more inside threads of current. A column of men, marching, turns as easily with twenty files abreast as with one, but only because the inside man has been trained to stand still and merely rotates on his axis until his companions have got around the corner. The inside threads of river current have no volition, no training to stop and wait for their neighbors outside. Their momentum carries them along and their number makes the turn longer, the meander belt wider.

In view of these considerations let us return to our table of meander belts and consider the stream width in each case. The table is here reproduced, omitting fall and discharge, and introducing two new columns, headed w for width of stream in feet, and $\frac{mb}{w}$, or ratio of meander belt to width of stream.

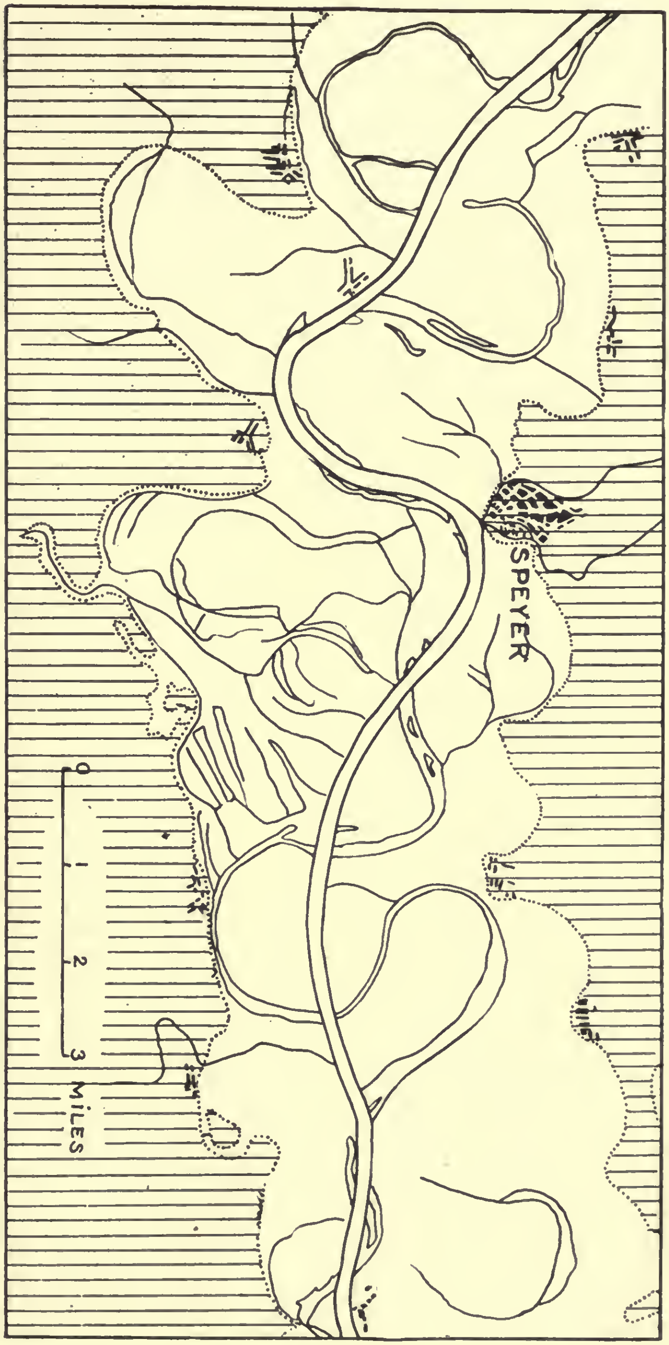
River.	mb	w	$\frac{mb}{w}$	Place.
Matfield.........	450	30	**15.0**	Elmwood, Mass.
Oder...............	4 688	243	**19.3**	Kosel, Silesia.
Mississippi.....	55,000	2,830	**19.4**	Greenville, Miss.
Etowah	4,000	260	**15.4**	Canton, Ga.
James............	8,448	660	**12.8**	Buchanan, Va.
Greenbrier.....	9,768	528	**18.5**	Alderson, W. Va.
Shenandoah ..	9,000	800	**11.2**	Near Potomac River
Tennessee......	26,400	1,400	**18.9**	Chattanooga, Tenn.

Here is a good suggestion of a constant value in the column $\frac{mb}{w}$. But these rivers were selected under constraint when I was trying to utilize the best meanders that occurred near points where measurements of volume had been made. We are now able to select the best flood plains, and on these the best-developed meanders on any American or European maps that are accessible. The list follows as Table A. No stream has been excluded because its ratio was discordant. Many were rejected because of too small a value of the quantity $\frac{mb}{d}$, which gives the ratio of measures at meanders across and along the general river course; d represents the distance from meander to meander along the river axis. Starred rivers have cuts-off near.

The mean meander ratio is **17.6.** Study would doubtless remove some of the discordancies. The Rhine near Speyer and Worms, as the accompanying map shows, is a corrected stream, flowing in an artificial channel. The width of the meander belt may be measured from the old course, which still subsists, but the width of the river, measured on the artificial channel, which is confined between walls, is probably less than that of the uncorrected stream that made the meanders. This must tend to give an excessive value to the meander ratio.

It is interesting to observe in the case of the Rhine that the flood-plain width is not far from the width of the maximum meander belt.

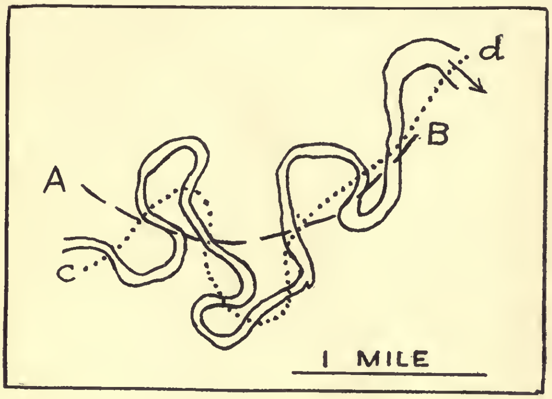
The small ratio for the Mississippi at Baton Rouge is of interest with the opener character of the meanders in the lower course, where each arm of the river seems to point away from the next arm upstream instead of swinging around toward it. A little farther and the river stops swinging, to rush headlong



The Rhine—A Corrected Meandering Stream

to the Gulf. The same opening out of meanders is noticed at Teesmouth and at the mouth of Seine and Dniester. The Panaro and Tagliamento come from their mountains overburdened with waste, and flow where it encumbers them in braided courses. The meandering stretch examined for each comes just below.

The facts ascertained by an examination of incised rivers are of sufficient interest to be now summarized in Table B.

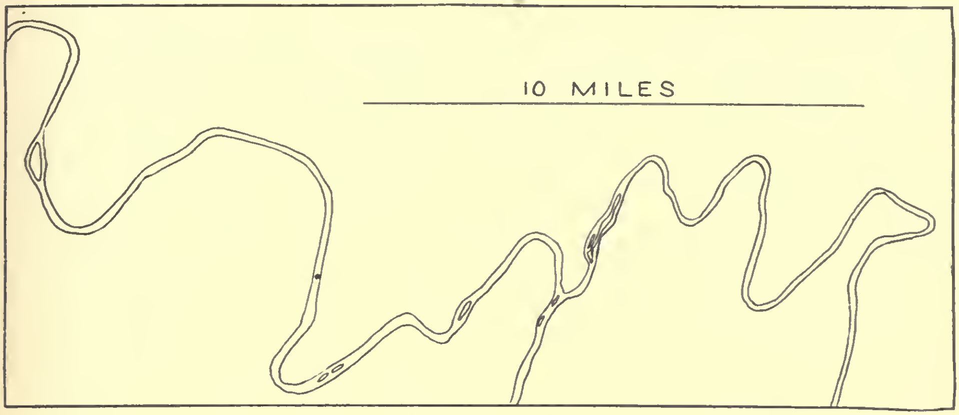


The Forth at Stirling

The ratios run high. The average is 30.6. Of all single rivers studied, the most interesting is the Dniester, with two measurements in each table. On the flood plain its ratios are 14.3 and 16.4, and 34 and 36 where incised in the mountains. This is the same story as the longer tables tell of meander belts that widen out as they are incised in the rocks. It is to be noted that the river widens in the mountains, but the meander belt widens even more.

The exceptionally high ratios for Seine, Oise, and Marne go with the quite as exceptional symmetrical form. The Seine and Marne at least are quite as regular in their curvature as the Mississippi and quite of the flood-plain type. Note the large ratio $\frac{mb}{d}$. One might look for some local cause for all three did not the Agout, in the southwest of France, agree with them. Yet farther from Paris, Seine 24 and Seine 26 have values nearer normal. Is there interference with the streams by walling or dredging sufficient to explain this abnormal ratio? The great use of these streams for interior commerce might easily lead to a deepening of the channels at important points, and this would tend to narrow the stream and increase the meander ratio. The width tabulated for Seine 25 is suspiciously small. This would be comparable to what has happened to the Rhine at Mannheim in the process of "correcting" that stream. Seine 25 and 26 have their channels divided in two by a continuous line of islands, as in the Rhine in the Schiefergebirge, but more numerous. Very likely the Agout has too great a width assigned to its meander belt because of what I may call *compounding* of meanders, which very often makes it hard to measure flood-plain streams, notably the Koros on the plain of Hungary. The accompanying sketch of the Forth at Stirling illustrates this compounding. *Cd* may be regarded as the immediate axis and *A B* as the original axis. Such forms are common in the small tributaries along the central valley of the Mississippi.

In contrast to the curves of the Seine just noted are the stiff zigzags of the Nolichucky and French Broad shown on figure 5, as characteristic of inherited incised meanders. We must think of them as once swinging freely on a low-lying plain, but their incision in the rising land has set them rushing swiftly from turn to turn where once they swung in curves. The deep-cut meanders of the canyons of the Colorado appear from the maps to have nothing of stiffness or zigzag in their form.



French Broad and Nolichucky

It should be remembered that there are no true maxima for incised meander belts, since the cut-offs that rebuke the flood-plain stream when it undertakes ventures beyond its strength cannot readily occur when the stream bed is sunk deep in the rocks. The average difference of the flood-plain meander ratios from their mean is 3.3, of the incised meander ratios 12.3. There is no necessary limit to meander belts when incised, and soft rocks may facilitate high values.

THE WIDTH OF STREAMS

A brief examination either of a stream or a good map shows width to be very variable, not merely from foot to foot, from mile to mile. The most striking case that I have come across is on the Prestonburg, Ky., topographic sheet, where Levisa Fork of the Big Sandy flows for 10 miles or so in the southeast part of the map with a pretty constant width of over 500 feet in a deep, narrow valley. Then for 5 or 6 miles near Prestonburg it is barely 300 feet wide, though the valley is opener. Later it again widens out to the northward. If correctly mapped, it is clear that such variations would be important in meander studies.

If examination be continued through the seasons, the changes at one place become very great. The fluctuations in height of the water at a river gage are incessant, not merely through the year and month, but even through the day. As the slopes that confine the stream waters to right and left are gentle, the fluctuations in width are much greater than the changes on the gage. At high stages particularly an inch rise on the gage may increase the width of the river by many feet. In drought stages there is a narrow thread of water meandering on its own law in the bottom of the stream bed; at flood time the whole plain is submerged, and if there is then a tendency to meander, it is in long curves wholly unlike those the river is familiar with. The meanders of the maps are, of course, those of the stream bed. This is confined by steeper slopes, but still by slopes, causing it to vary in width as the water falls or rises. It is in this bed that the stream is when it carves its meanders, and if it varies there in width, so is the stream bed the scene of varying meander tendencies. Some of the irregularities in the resultant meanders are due to this cause. For the Preliminary Map of the Lower Mississippi the stage adopted for mapping is about one-third of extreme oscillation above low water. For the United States topographic maps such details probably do not come within the limits of accuracy aimed at.

It would be desirable to know for every stream the width at which the water stands longest. In practice the measurements taken from the maps are subject to errors so much greater than this uncertainty of stage that no great harm results from its neglect. In field-work mapping should have regard to this point.

CONCLUSION

There are already depicted on good maps many river courses to which the criteria suggested may be applied. Abnormal results should be traceable to local conditions. But the vast majority of meandering rivers are too small to admit accurate measurement from such mapping as they are likely to get. The essential measurements are easily made on the ground.

It is now evident that the Matfield, the study of which has led to this discussion, has not a typical flood plain. A 30-foot river demands a 540-foot meander belt. This it hardly has between its bluffs, as a glance at the map will show. The river is still cutting at these bluffs to remove the restraint they now exercise on its meander system. Though its plain may be called incised, it is not due to the incision of meanders inherited from a previous cycle, but they are rather now first developing on a somewhat uneven surface of glacial deposits. The presence side by side of oxbows and sloughs with the close-pressed course against the bluffs suggests some distinctive epithet like hindered, embarrassed, or bluff-bound, rather than simply undeveloped.

PEARY'S WORK IN 1901-1902

AFTER four years of brilliant explorations in the far north, Peary has returned to the United States and his last Arctic campaign is ended. A summary of his work during the first three years of this last expedition appeared in the October, 1899, and October, 1901, numbers of this magazine. His work during the past year is summarized in the following modest report to Mr H. L. Bridgman, secretary of the Peary Arctic Club:

OFFICIAL REPORT BY ROBERT E. PEARY

Dated Sydney, September 7, 1902

Left at Erik Harbor, on the Ellesmere coast, August 29; the party reached Payer Harbor September 16; crossing Rosse Bay partly by sledge and partly by boat, then walked across Bedford Pin Island.

About a week later my Eskimo began to fall sick, not one escaping. By November 19, six adults and one child were dead; nearly all the others very weak, but out of danger. Early in January Eskimo came across from Anoritok, bringing news of the ravages of a fatal epidemic through the tribe. Word was sent back by these scouts for as many of the survivors as could to come to me, and by the end of the month they began arriving.

In February a large depot of dog-food was established near Cape Louis Napoleon, some 60 miles north of Sabine.

March 3 my advance party of six sledges, in charge of Henson, left for Conger.

March 6 I started with the main party of 18 sledges, leaving Percy in charge at Payer Harbor.

Conger was reached in 12 marches, arriving within an hour or two of the advance party.

My supporting party of Eskimo returning from Conger brought down the instruments, chronometers, and Arctic library.

Eight marches more took us to Cape Hekla. The north end of Robison Channel was all open water to the Greenland coast, and lakes of water extended northward as far as could be seen from Black Cape and Cape Rawson.

From Hekla another supporting party returned.

April 1 I started northward over the polar sea with Henson, four Eskimo, and six sledges.

Old floes covered deep with snow and intersected with rubble ridges and lanes of young ice were encountered from the moment we left the ice foot. The same kind of traveling (except the lanes of young ice) was found by the English expedition of 1876.

After six marches open leads and floes in motion were encountered. Two natives were sent back.

As we advanced the floes became smaller, the pressure ridges on a grander scale, and the open leads more frequent. Each day's march was very tortuous and our general course deflected west by the character of the ice.

Finally at 84° 17′ north latitude, northwest of Hekla, the polar pack became impracticable and further efforts to advance were given up. New leads and pressure ridges, with foggy weather, made our return in some respects more trying than the advance. Hekla was regained April 29 and Conger May 3. Leaving Conger May 6, Cape Sabine on the 17th, a few days later, I went north as far as Cape Louis Napoleon to complete the survey of Dobbin Bay, returning the first of June.

A proposed trip westward across Ellesmereland was prevented by open water in Buchanan Bay. The ice broke up earlier than in 1901, and Payer Harbor was blockaded almost continuously.

The *Windward* bored her way through the ice and entered the harbor on the morning of August 5, and got out the same afternoon, with scarcely 15 minutes to spare before the harbor was closed by the ice. Forcing our way across Smith Sound, my Eskimo with their belongings were landed in Inglefield Gulf, and several days devoted to hunting walrus for their winter subsistence; then the *Windward* started south, reaching and leaving Cape York the afternoon of August 28.

Calling at Godhaven, Greenland, and Cape Haven, Baffinland, the *Windward* arrived at Choteau Bay, Labrador, September 14 and sent dispatches.

The summer voyage has been without mishap, and the *Windward*, with her new engines, has made as good time as the larger and more powerful ships that have been going north the past ten years.

The year at Payer Harbor was passed comfortably, though the anxious strain caused by the ravages of disease among my faithful people was not light. Food was abundant, and our supply of musk ox and deer meat continuous throughout the year.

The northern sledge trip in the spring was arduous, but not marked by special exposure, suffering, or danger more than is necessarily incident to serious Arctic work.

The equipment and personnel was satisfactory, and further advance was vetoed by insuperable natural conditions.

The *Windward* has on board the instruments, chronometers, and Arctic library abandoned by the Greely expedition at Conger, numerous specimens in natural history, bear, musk ox, reindeer, and walrus skins, skeleton of a two-horned narwhal, a rare Arctic specimen; also living specimens of musk ox, walrus, Arctic hare, and Eskimo dogs.

Anchor and chain lost by *Erik* last summer are on board.

The *Fram* left Godhaven about August 20, bound home. She has been in Jones Sound, from whence it is understood explorations were made to the northwest. One death, a fireman, is reported since 1899. Others on board said to be well.

The little schooner *Forgetmenot*, caught in the ice at Cape Haven last year, is now on her way to St Johns.

(Signed) PEARY.

SUMMARY OF PEARY'S WORK

Mr Peary has devoted practically the whole of the last twelve years to Arctic work. He announces that he has now retired from Arctic exploration and will hereafter devote his energies to his profession, civil engineering. The results of his long labors in the far north are most important. He has proved Greenland an island and mapped its northern coast line; he has defined and mapped the islands to the north of Greenland, known as the Greenland Archipelago; he has shown that an ice-covered Arctic ocean probably extends from the Greenland Archipelago to the North Pole; he has accurately defined the lands opposite the northwestern coast of Greenland, Grant Land, Grinnell Land, and Ellesmereland; he has reached the most northerly known land in the world; he has gained the most northerly point yet reached on the Western Hemisphere, 84° 17′; he has studied the Eskimo as only one can who has lived with them for years; he has added much to our knowledge of Arctic fauna and flora; of the musk ox, the Arctic hare, and the deer; the notes he has made during the past years will benefit meteorology and geology—all these are some of Lieutenant Peary's achievements during the twelve years he has so valiantly battled in the far north. But, above all, Mr Peary has given the world a notable example of a brave and modest man who, in spite of broken limbs and most terrible physical suffering and financial discouragements, has unflinchingly forced to a successful end that which he had decided to accomplish.

To Mrs Peary, the able seconder of her husband's plans, and to Mr H. L. Bridgman, the efficient secretary of the Peary Arctic Club, and the loyal members of that club, much credit is due.

G. H. G.

GEOGRAPHIC NOTES

RECLAMATION SERVICE

On June 17, 1902, what is known as the "Reclamation Law" was signed by the President. This appropriates the receipts from the sale and disposal of public lands in certain states and territories to the construction of irrigation works for the reclamation of arid lands. Thirteen states and three territories are named in the bill, viz, the states of California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming, and the territories of Arizona, New Mexico, and Oklahoma. The funds made available are those received during the fiscal years ending June 30, 1901 and 1902, and subsequent years. The amount has not been specifically given by the Treasury Department, but is unofficially stated to be three millions for 1901 and four and a half millions for 1902.

The work authorized by the law is that of surveying and examining opportunities for water storage and diversion of large rivers, and also the location and construction of the works when found to be feasible. The cost of these is to be returned to the reclamation fund and used again in construction.

In 1888 the Director of the United States Geological Survey was authorized to make examinations of this character, and extensive surveys were begun at the time. The appropriation for these was cut off at a later date, excepting as regard the topographic surveys of the catchment basins. In 1894, however, appropriations were made for measuring the streams and determining the water supply, and the funds for this purpose have been increased until now, the year ending June 30, 1903, there is available the sum of $200,000.

The information obtained under the authority of the law of 1888 and of subsequent acts has been published in the reports of the Geological Survey. In obtaining the data a considerable number of skilled engineers have been employed and a separate division formed, known as the Hydrographic Branch of the Geological Survey.

Upon the passage of the Reclamation Law, the Secretary of the Interior, to whom is entrusted the administration of the reclamation fund, received from the Director of the Geological Survey a plan for putting the law into immediate effect, and on July 8, these suggestions being approved, active work was begun. This is in effect a continuation and enlargement of the work of the Hydrographic Branch. Instead of organizing a new bureau, the Secretary authorized the gradual creation within the Hydrographic Branch of a corps of engineers to be known as the "Reclamation Service," these men retaining their connection with the Geological Survey, but receiving additional assistants and being assigned to a larger field of work.

The great advantage derived from the creation of the Reclamation Service within a well-established bureau is that it is able to obtain the services of skilled and experienced men, and does not pass through the vicissitudes incident to the formation of new rules and regulations and the originating of precedents for all of its operations. The Reclamation Service as thus established is able to proceed at once with the work contemplated by the law with the least amount of time consumed in preparation, and it is safe to say that at least a year has been saved in this way. The new men added are young engineers, graduates of professional schools, selected after competitive examination from the eligible lists of the Civil Service Commission.

The official in charge of the work as designated by law is the Secretary of the Interior, Hon. Ethan A. Hitchcock. He has referred the surveys and examinations and making of recommendations for construction to the Director of the Geological Survey, Hon. Charles D. Walcott. The charge of the work is by him entrusted to the Chief Engineer, Mr F. H. Newell. The latter is also Chief Hydrographer of the Geological Survey, and is conducting stream measurements in various parts of the United States. The principal engineer next in rank is Mr Arthur P. Davis, well known for his work on the hydrography of Nicaragua and Panama.

Before the passage of the Reclamation Law detailed surveys had been begun in Montana on St. Mary's Lakes and outlet, in Nevada on the Truckee and Carson Rivers, in Colorado on the diversion of Gunnison River, and in Arizona on the San Carlos and Salt River reservoirs. After the passage of the law this work was pushed forward more vigorously, the field parties being increased. Examinations have been begun on Yellowstone River in Montana, on the Snake River in Idaho, on the Bear River in

Utah, on the South Platte River near Sterling, Colo., on Grand River near Grand Junction, Colo., to take water into Utah, and on Colorado River in southern California and western Arizona. A number of other important projects are awaiting consideration and will be taken up as rapidly as experienced men can be obtained through the Civil Service Commission.

This law is regarded as one of the most important in the development of the public lands of the West. It is of concern not merely to the western people, but even more so to those of the entire country who are seeking homes or employment or who have goods to be sold or transported to the new communities which will be formed. The successful administration of the law means a great change in the western half of the United States through the upbuilding of homes in regions which are now desert but where there are great possibilities latent. The men having the work in charge are keenly alive to the responsibilities resting upon them and are endeavoring to guard the work from destructive influence and keep it on a sound, business-like basis. For this reason, great emphasis has been placed upon the necessity of keeping the personnel strictly on civil-service lines, employment and promotion being dependent upon efficiency and experience. In the same way the selection of projects for consideration and report is being made upon the basis only of public importance and feasibility, the refunding of the cost and the settlement of the greatest number of people upon the reclaimed lands.

COAL IN ALASKA

DR C. WILLARD HAYES, Geologist in Charge, U. S. Geological Survey, is in receipt of a telegraphic report from the Collier expedition announcing that they had reached Seattle en route to Washington, and giving the leading results of the season's work. The party of three, with Mr Arthur J. Collier in charge, left Washington early in May, to explore portions of Yukon Valley, in which the existence of coal was rumored. The telegraphic report indicates that they have discovered large bodies of good coal adjacent to the river and within reach of transportation facilities.

THE SVERDRUP ARCTIC EXPEDITION

PRESS dispatches from Christiania and Stavanger, Norway, convey gratifying announcements of the success of the Arctic expedition of the *Fram*, led by Captain Otto Sverdrup.

The *Fram* sailed from Christiania June 24, 1898, with a crew comprising Captain Sverdrup, commander; Naval Lieutenant Victor Baumann, astronomer; Lieutenant Guy Ysachsen, cartographer; Dr H. Svendsen, meteorologist; Dr Ed. Bay, zoölogist; Dr Herman G. Simons, botanist; Dr P Schell, geologist; Dr Draskrug, surgeon, together with nine seamen. The *Fram* is owned by the Norwegian Government, which not only granted Captain Sverdrup permission to use the vessel, but supplied him with the funds requisite for outfitting the expedition.

The primary purpose of the expedition was to explore and map the northeastern and northern coasts of Greenland, and to trace the connection between Cape Washington and Independence Bay; but on learning that a considerable part of this task had been already accomplished by Peary, Sverdrup changed his design, and undertook to survey the unknown coasts of Ellesmereland, with adjacent portions of the Arctic Archipelago. Great difficulties were encountered. For nearly three years the *Fram* lay almost motionless in the ice of Jones Sound, despite repeated attempts to free the craft by both sawing and blasting.

Game was found in abundance; a hundred musk oxen were killed for food. The most serious loss suffered by the party was that of the death of Surgeon Draskrug, whose body was buried in the ice. Several cases of illness were successfully treated by Captain Sverdrup after the death of the surgeon.

According to the meager reports issued through the press dispatches, "the districts explored were the southern and western coasts of Ellesmereland and the hitherto unknown districts west of that region. The boiler of the *Fram* shows signs of usage, but everything is in good order."

The vessel left Gothaab, Greenland, August 16, but an accident to the machinery compelled her to make the homeward passage entirely under sail. On September 28 the *Fram* entered Christiania harbor under the escort of warships and pleasure steamers, and was saluted by the fort and welcomed by thousands of spectators. The latest advices announce a reception to Sverdrup and his companions given by the Geographical Society on September 30, at which the Captain was decorated with the Order of the Grand Cross of St Olaf, while Seaman Peter Hennicksen (who had participated also in the Nansen Arctic expedition) received a gold medal, and other members of the expedition received silver medals. The dispatches quote Sir Clements R. Markham, president of the Royal Geographical Society of Great Britain, as regarding Captain Sverdrup's expedition as the most important since that of Sir John Franklin.

The geographic results of the Sverdrup expedition remain to be described. According to Sir Clements Markham, as reported in the dispatches, the expedition skirted three thousand miles of coast, of which half was newly discovered land. Unquestionably the surveys will supplement those of Peary and others, and with them bring into the domain of actual knowledge a large part of Arctic America.

THE BROOKS ALASKAN EXPEDITION

DR A. H. BROOKS, of the U. S. Geological Survey, has just reported by wire the successful termination of a notable season's work in Alaskan exploration. Entering by way of Cook Inlet, he so laid his course as to divide the largest unexplored area in Alaska. This he traversed, skirting the base of Mount McKinley and making fresh observations on this culminating point of the North American continent, coming out on the Tananak. The brief telegraphic report indicates that the plans for the work were successfully carried out, without serious casualties.

REPORTED ENTRANCE OF LHASSA

IT is currently reported in Hamburg that one of the seven Japanese Buddhist priests who have been endeavoring to enter Tibet has succeeded, and that he is now in Lhassa. It is said that this priest went in from Darjiling, and that two others are approaching the sacred city from Mongolia. The third party passed up the Yangtse Valley toward the frontier about a year ago, but their present whereabouts are unknown.

Miss Eliza R. Scidmore, Foreign Secretary of the National Geographic Society, is in Hamburg as a delegate from the Society to the Thirteenth International Oriental Congress.

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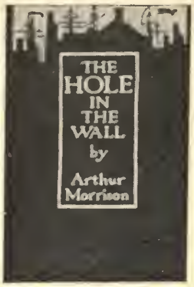

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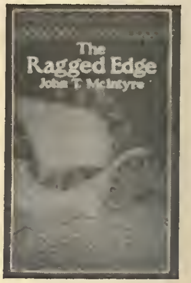

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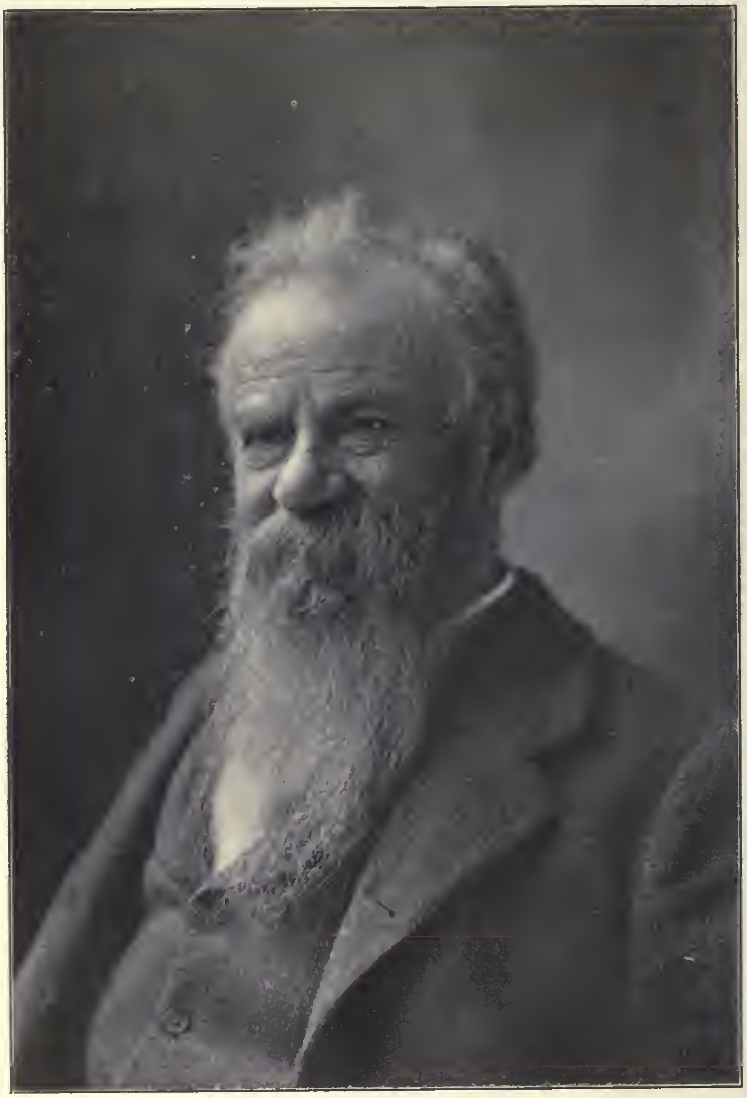

John Wesley Powell

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JOHN WESLEY POWELL

JOHN WESLEY POWELL died at his summer home in Maine September 23, 1902. He was born at Mount Morris, New York, March 24, 1834. Few men in the history of the United States have left behind them such a deep and lasting impression on the practical scientific work of the nation.

Major Powell was of English parentage, his father and mother settling in the United States a few months before his birth. He passed his boyhood working and managing his father's farm and gaining such education as the rural community could offer. Later he supported himself by teaching school, meanwhile working hard at his favorite studies, natural history and geology. In the pursuit of specimens for his collections he made long voyages in a skiff on the Mississippi, Ohio, and Illinois Rivers in the years preceding the Civil War. He served in the Union Army throughout the war and gained the rank of lieutenant-colonel, but he has always been known to the public as Major (not Colonel) Powell. He had lost his arm in the battle of Shiloh, and, as the wound never completely healed, he suffered fearful torture at times during the rest of his life.

The public will probably always remember Major Powell most prominently for his dramatic exploration of the Grand Canyon of the Colorado in 1868 and 1869. His modest official narrative of the journey for hundreds of miles between the perpendicular walls of the canyon aroused intense feeling throughout the country and is still read with unabating interest.

In 1879 Major Powell was appointed the first Director of the Bureau of American Ethnology, at the head of which he remained until his death. In 1881 he was also appointed Director of the United States Geological Survey, and for thirteen years guided the policy of the Survey. In this brief article it is possible to mention only some of the work he organized and developed while at the head of these great bureaus, in whose formation he had also taken a prominent part—the importance of an adequate topographic mapping of the United States, the necessity of irrigation to the West, and principally the definite and sympathetic study of the American Indians.

During the last years of his life, in order that he might give his time to his personal studies in psychology and philosophy, Major Powell entrusted to his principal and devoted assistant, Dr W J McGee, the practical management of the Bureau of which he was the head.

Major Powell possessed a faculty of suggesting ideas to others and of inspiring others to carry them out. This element of his personality Dr G. K. Gilbert, for many years a close personal friend of Major Powell, brings out very clearly in a biographical sketch published in *Science* of October 10, 1902:

"In summarizing the results of his active life it is not easy to separate the product of his personal work from that which he accomplished through the organization of the work of others. He was extremely fertile in ideas, so fertile that it was quite impossible that he should personally develop them all, and realizing this he gave freely to his collaborators. The work which he inspired and to which he contributed the most important creative elements I believe to be at least as important as that for which his name stands directly responsible. As he always drew about him the best ability he could command, his assistants were not mere elaborators, but made also important original contributions, and the ideas which he gave the world through others are thus so merged and mingled with theirs that they can never be separated. If we count the inspiration of his colleagues as part of his work of organization, then the organization of researches may properly be placed first in the list of his contributions to the progress of science." G. H. G.

THE COURSE OF THE RETAIL COAL TRADE

By Dr. David T. Day,

Chief of Division of Mineral Resources, U. S. Geological Survey

ON the average the total consumption in the United States of fuel of all kinds—hard and soft coal, wood, natural gas, and petroleum—is equivalent to about five tons of coal per year for each man, woman, and child. Of this about two-thirds of a ton is anthracite and, approximately, three tons bituminous coal. At the mouth of the mine the anthracite is worth about $1.50 a ton and the soft coal $1 a ton. As a rule, the coal must be hauled not more than 150 to 200 miles to the consumer. These figures are low, compared with the cost in other parts of the world.

The most fortunate element in these fundamental facts of our fuel supply is the short distance which the coal must be hauled from the mines to the consumer. In other words, coal deposits are very generally distributed over the United States. This is a feature of greatest consequence in our exceptional prosperity as a nation. Further, the condition of the forests is still such that where there is least coal, wood is generally cheap. Again, there are great tracts of country where natural gas, and occasionally petroleum, can be used to prevent any great rise in the price of the general fuel, coal.

It is a very difficult matter for the average citizen to reconcile this low price at the mine with the actual cost of the coal delivered at his residence. This cost at the point of delivery ranges in ordinary times from 70 cents per ton, as a minimum, to over $10 for anthracite at a remote distance. The railroad companies seldom receive less than a dollar a ton as their total charge for loading, transporting, and distributing a ton of coal, nor often more than $2.50. Thus, on the average, the freight more than doubles the cost of the coal by the time it reaches the city for consumption.

Curiously enough, for only a few cents more than the rate for a short haul coal is often hauled over five times as many miles to competitive points. Thus the rate of hauling coal varies from one-tenth of a cent per ton for each mile hauled, as a minimum rate, to over twenty times that rate on certain short hauls. It costs the retail dealer $1 to take the coal from the cars and deliver it in the consumer's cellar. The remainder of the cost of a ton of coal to the consumer represents the dealer's profit. Thus, in New York the price of anthracite for stove size on the resumption of mining after the strike was $5.00 per ton at the dealer's yard. The cost of delivering this was as follows: Unloading at yard, 25 cents; insurance, 2 cents; screening, 10 cents; hauling to consumer, 38 cents; delivery in cellar, 25 cents—total, $1.00.

The general retail price is put down as $7.00, leaving the profit of the dealer $1.00, or 20 per cent on his cost. Under these conditions the supply of coal in the United States has been generally well up to the demand, and the trade has been fairly satisfactory; so that the public has taken little interest in the general coal supply beyond the mere price for each particular locality. The regions to be served by bituminous coal and those supplied by anthracite have, in general, been well defined. There has been keen competition at only a few points. In general, the requirements of the trade were well known and amply supplied, but late in the spring of this year anthracite mining was abruptly stopped by the great strike, and the small stock in the hands of dealers was at once at a premium. This small supply, which was weekly supplemented by meager shipments of coal washed from waste dumps at the mines, was carefully husbanded and doled out only where absolutely necessary, like food in a siege or a famine. The previously satisfactory supply of coal was profoundly disturbed. Anthracite supplied practically the entire fuel for a certain well-defined territory, including the states of New York, New Jersey, eastern Pennsylvania, and including also the principal consumers of coal as far south as Washington.

In calling this strike the miners took advantage of a favorable opportunity for continuing the discussion of issues between the coal miners and the operators, which they did not consider satisfactorily concluded at the previous great strike, which lasted from September 17 to October 27, 1900.

The issues of the strike which has just closed, as definitely stated, are as follows:

"1. That there shall be an increase of 20 per cent to the miners who are paid by the ton—that is, for men performing contract work. These men involve about 40 per cent of all the miners.

2. A reduction of 20 per cent in the time of per diem employés. The mines are operated about 200 days per year, ten hours per day. This demand, if granted, would result in reducing the day to eight hours (20 per cent), so that the mines would be operated 240 days at about the same pay; hence an equivalent of 20 per cent increase in the earnings, no increase in the rates of per diem employés being demanded.

3. That 2,240 pounds shall constitute the ton on which payment is based for all coal mined where the miners are paid by weight. This would apply in

any district where weighing coal would be practicable and to those miners who are paid by the quantity, and not to those paid by the day.

These are the specific demands formulated from alleged grievances existing in many ways at many of the collieries. They have been sources of increasing irritation between the miners and their employers for many years. Many of them have actually resulted from efforts of mine managers to devise the most intelligent means to make the amount of money earned the same in different mines for the same amount of work. Owing to the varying conditions in the different mines, particularly the varying thickness of the veins in which the miners work, different rates of pay are necessary where the miner is paid according to the amount mined. The amount which a miner should receive for a ton of coal is further complicated by the proportion of slate which he sends to the surface in the coal. Rank carelessness in this respect on the part of the miner has led to much irritation with the company. It has led to the practice of guessing as to how much worthless slate is contained in every car of coal which is sent to the surface. Although the guessing is usually close, it is recognized as guess-work, and the miners are never contented with any system of book-keeping in which guess-work forms part. Guess-work and irritation will always be intimately associated in the anthracite mines.

Among the different plans for adjusting the amount of wages to be paid in mining different seams of coal, the very intelligent method has frequently been used of paying a uniform price per car-load, and then varying the size of the car so as to fit the thickness of the vein in which the miner worked, so that the thinner the vein and the more difficult the mining, the less coal required to constitute a car-load. This varying car-load has always been looked upon with suspicion by the miner and has added to the general irritation.

The coal strike of 1900 raised the general wages 10 per cent and did away with the artificial price charged for powder. The other sources of irritation remained and formed a considerable incentive for continuing the efforts for further discussion of the whole wage question with the operators at the first convenient opportunity. It must be pointed out also that beside the question of an arbitrary docking of the miner for slate in his coal, and the variable size of the car used, some change in the rate of pay, or, what is the same thing, the length of a day's labor, must be made in favor of the men who work by day's labor, if the newly made alliance of the anthracite miners with the United Mine Workers of America should be continued. Therefore, to hold all the day laborers, the engineers, pumpmen, etc., in the organization, the other claims were added to the formal demands on the operators. The strike promptly resulted on the 12th of May, when the operators refused even to consider these grievances, claiming with considerable justice that the settlement after the strike of 1900 had been accepted by the miners as satisfactory. On May 22 even the so-called "washeries," where the finer sizes of anthracite are separated from the old refuse dumps which have accumulated for many years, closed down. On June 2 the union, recognizing that the engineers and pumpmen were prospective gainers by the strike, called on the men to abandon the pumps and join in the strike. These men have heretofore been exempt from striking. They are employed permanently by the companies, and their work must go on, day and night, permanently, in order that the mines may be kept in good condition for future work. Calling them out involved a radical change in the attitude of the strikers. The irritation between the strikers and employers was manifestly increased, with the result that troops were ordered to the mines and preparations for a long fight were completed on both sides.

Although bituminous coal is the popular steam-raising fuel in most industrial centers, this is not the case in the neighborhood of New York, and few people appreciate the enormous number of manufacturing interests in the vicinity of the great metropolis. The supply of anthracite was rapidly cut off, and it was necessary to divert soft coal from its regular channels to supply a shortage of about one-fifth of our total supply and to furnish it in a region of the greatest industrial activity. To many small industries it brought great hardship; to laundries and bakeries, for example. It requires half a pound of coal to bake a loaf of bread.

Anthracite is looked upon as the fuel for household use, but the famine came in the warmer months, when none was needed for house-heating. The great majority of the users of hard coal took little heed of it, nor did the general public have any conception of the hardships actually suffered by industrial enterprises around Philadelphia and New York in securing a substitute for anthracite.

In 1898 the price of soft coal was much lower than now, on account of overproduction. At first sight it would appear probable that this extra demand for soft coal to replace anthracite would have furnished a welcome outlet for extra production. Such was not the case. The soft-coal producers had reduced their yield and had also fortified themselves by yearly or longer contracts. It was necessary to fill these contracts, and only the surplus was available for the new trade. A more important obstacle to the relief from the bituminous mines was the difficulty in furnishing cars and motive power for hauling the coal from more remote bituminous mines. The capacity of the railroads had been limited closely to the previous conditions, in fact, too closely; for a shortage of cars was felt even under normal conditions in the previous year. Recognition of this condition made it worse, for every one hoarded coal. Thus an anthracite famine in the seaboard territory led to general coal scarcity far beyond the region of anthracite's usual influence.

Our average citizen is habitually trustful and good-natured, and as long as continued warm weather postponed the necessity for house-heating, he dismissed the coal situation with faith that coal would be forthcoming by winter. By October 1, however, it was evident that the end of the strike was as far removed as ever. The efforts of Pennsylvania's political forces to secure a compromise were futile. This strengthened the miners and also reinforced the determination of the operators. The outlook at once became serious, and the condition was laid clearly before the people by the action of the President. This action served two other valuable purposes; it caused the Governor of Pennsylvania to use all his resources for the maintenance of peace in the anthracite coal region, and it served notice on the retail dealers who were hoarding coal that the strike was soon to end. In fact, they had less than two weeks in which to market their hoarded reserves. With the calling of the conference on October 3 went the full assurance to every one that the strike would be ended by the President.

This article is designed, not to show the course of the great strike; still less to point out any lines of just and permanent settlement—conclusions which must follow the careful investigation of the Commission—but to outline the past and prospective course of the retail coal trade. The announcement of the close of the strike marked high tide in the bituminous coal prices. The haste of all the producers to market every ton possible while high prices prevail, can have only one result—lowering prices to somewhere near a legitimate basis. The anxiety of the householder to fill his cellar at the present time is materially lessened by the hope of cheaper coal in the near future. In the meantime the coal scarcity has aroused great interest in all practical (and many impracticable) substitutes for this kind of fuel. The recent interest in the oil fields of Texas rendered logical the efforts to substitute fuel oil for coal, and yet these efforts were practically fruitless, simply because in the territory particularly concerned, oil can never be a cheap fuel for heating purposes. It may be that the coal famine caused some slight advances in the construction of devices for burning oil in stoves and furnaces, but even when perfected, the cost of the fuel would be prohibitive. It can be briefly stated that oil at ten cents per gallon is about the equivalent of coal at $20 per ton. It is quite possible that a beneficial result from the efforts to use oil may come at some time in the future, when the discovery of some new crude oil field may make it possible to spray crude oil into furnaces with an ordinary steam jet, with an economical result, and with the many advantages which come from a liquid fuel. But many devices recommended, such as soaking bricks with kerosene, must be dismissed as absolutely unworthy of consideration.

It may also be possible that the advance in the construction of devices for burning refined oil, similar to the type of burners furnishing the Kitson light, may be sufficient to furnish a useful means of heating kitchen ranges in the summer time, in the place of illuminating gas. The two substitutes for anthracite which on the whole have gained in favor by means of the strike are bituminous coal and its two products—coke and illuminating gas. The use of gas ranges has permanently increased as a result of the strike. The advantages of coke have become more manifest, and the advantages of soft coal in raising steam, even in household steam-heating plants, have been very favorably received by the public. On the other hand, the regret which will be felt at the general introduction of soft coal and its accompanying pall of smoke are so great as to justify much further endeavor to market this soft coal after it has been converted into the more agreeable forms of cheap fuel—gas and coke.

SUBMERGED VALLEYS IN SANDUSKY BAY

By Professor E. L. Mosely, Sandusky, Ohio

AMONG the captains o vessels and others who have occasion to notice the stage of the water from time to time, the impression prevails that Lake Erie is getting lower, and that many of the harbors now in use are likely to become unsuited to deep-draft vessels. Some of them remember the high water of 1858–1860, higher than they have ever seen since, while so recently as 1895 the water was lower than they had ever seen it before. Since 1895 it has been rising, and now stands about 16 inches higher than at the same time last year. These fluctuations are due mainly to variations in the rainfall on the drainage basins of Lake Erie and the upper lakes. This year at Sandusky, in the two months June and July, more than half as much rain fell as in the fourteen months beginning January, 1901. Examination of Weather Bureau records since the establishment of stations at upper lake ports shows that unusually high water in Lake Erie has been preceded by periods of unusually heavy rains.

If, however, considerable periods of time are considered, there is abundant evidence to show that the lake is deepening instead of getting shallower, as limited observation has seemed to indicate; nor is the process too slow to be noticed in a lifetime. Old men who were living only a few years ago at Put-in-Bay, Port Clinton, and Sandusky could remember that when they were boys there was little or no water where it has since been several feet deep. Testimony of many witnesses in a lawsuit at Sandusky in 1844 showed that east of the city the water had been deepening since about 1823. Gauge readings at Erie and elsewhere show that at several times in the first half of the nineteenth century the water was lower than it has ever been since, and in the first quarter of the century considerably lower than in the second quarter. The high water of 1858–'60 killed many trees that stood on the border of marshes connected with the lake. Hickory, walnut, elm, and sycamore of large size and probably more than 200 years old were killed at this time by high water keeping the ground too wet around their roots. Stumps are still standing with roots in place, their tops now below the level of the lake. In the caves of Put-in-Bay stalagmites and stalactites, which can be formed only in the air, may be seen several feet below the present lake level, where they are being slowly dissolved.

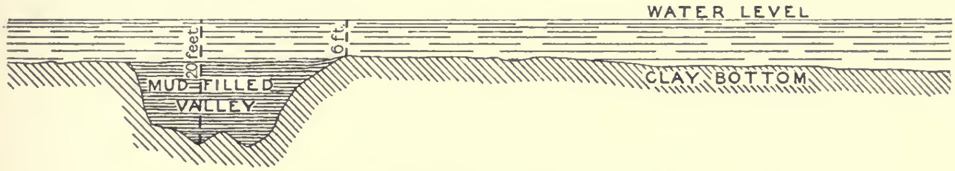

Figure 1.—East and West Section—One Mile Long

If we look for a cause of this deepening of the lake, it is to be found in a slow tilting of the earth's crust in the Great Lake region.

The old beaches so much utilized for roads in northern Ohio and farther east are roughly parallel with the south shore of Lake Erie, but several miles away from it. They were formed at the margins of glacial lakes whose waters, being confined by the ice on the north and northeast, found an outlet to the Mississippi, first at Fort Wayne, Indiana, and later at different places across Michigan, the different beaches corresponding to the different levels of the outlets. Each beach at the time of its formation was approximately level, being formed at the margin of a lake. Now, however, they show a rise as they are traced eastward. The Forest beach, upon which Euclid Avenue, Cleveland, is laid out, is the lowest and most recent of these beaches. "At Crittenden, N. Y., it is 168 feet higher than at Cleveland."* This shows a rise of the whole region to the east as compared with that to the west, involving a rise of the outlet of Lake Erie as compared with the rest of the lake and causing a deepening of the water, especially at its western end.

Examination of the lake beaches does not show whether the tilting of the earth's crust is still going on or ceased centuries ago. By comparing the heights above the normal lake level in 1895 of a bench-mark in Cleveland and one at the head of the Welland Canal with the heights of the same as carefully determined in 1858, G. K. Gilbert found that the point near the northeast end of the lake rose as compared with the point in Cleveland. (See the NATIONAL GEOGRAPHIC MAGAZINE for September, 1897.) This tilting of the Great Lake basins, still continuing, is doubtless the cause of the deepening of the water witnessed by old residents and shown by gauge readings and the submergence of stalagmites and stumps. That it was going on continuously for centuries before the first settlements were made on the shores of the lake and before the oldest trees killed by the high water of 1858 began to grow we have considerable evidence to show.

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* Leverett.

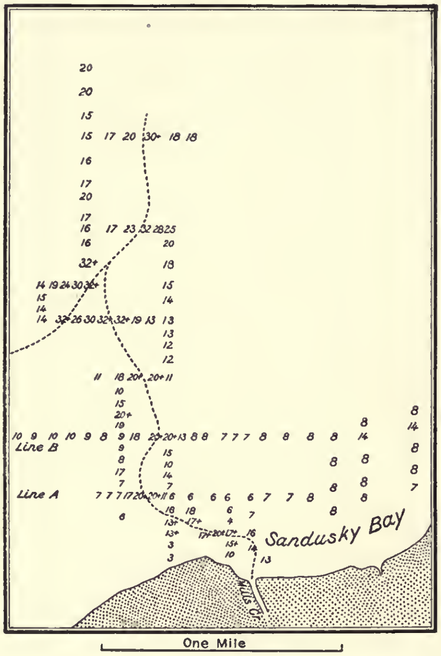

Figure 2.—Depth in Feet to Clay

As the lake has deepened it has extended over the lowlands about its western extremity, forming marshes at the mouths of all the streams, making bays of some of the marshes, converting peninsulas into islands and islands into reefs. At many places in northern Ohio roads and houses have been moved south on account of the encroachment of the water. Many orchards have fallen into the lake. The same is true of the Canadian shore. Nowhere is there any building up at all comparable with the amount of land lost. Since 1809, when the first survey was made, more than 500 acres have been lost in Erie county along the lake and in the eastern part of Sandusky Bay, while the enlargement of the western part of the bay probably amounts to several square miles. That Put-In-Bay, Kelleys Island, and the others in the western part of Lake Erie were cut off from the mainland in earlier centuries by the gradual extension of the lake is shown by a study of their flora. All the plants that are well distributed in similar soil on the mainland are found also on the islands, and it is difficult to see how some of them could have reached the islands while the latter were separated by such wide expanses of water as now exist. (For a full discussion of this see Sandusky Flora, Ohio State Academy of Science, Special Papers, No. 1.)

As the water has risen it has extended the lake level into the valleys of streams, so that navigable water is found along the lower portion of many streams whose drainage area is so small that the stream, if seen at any point above slack water, might be regarded insignificant.

In January, 1901, an attempt was made to trace out into Sandusky Bay the valleys of some of the streams that enter it by examining the bottom with an auger suitably rigged. The plan proving feasible, the work was continued as long as the ice was safe that winter and the next. The bottom of the

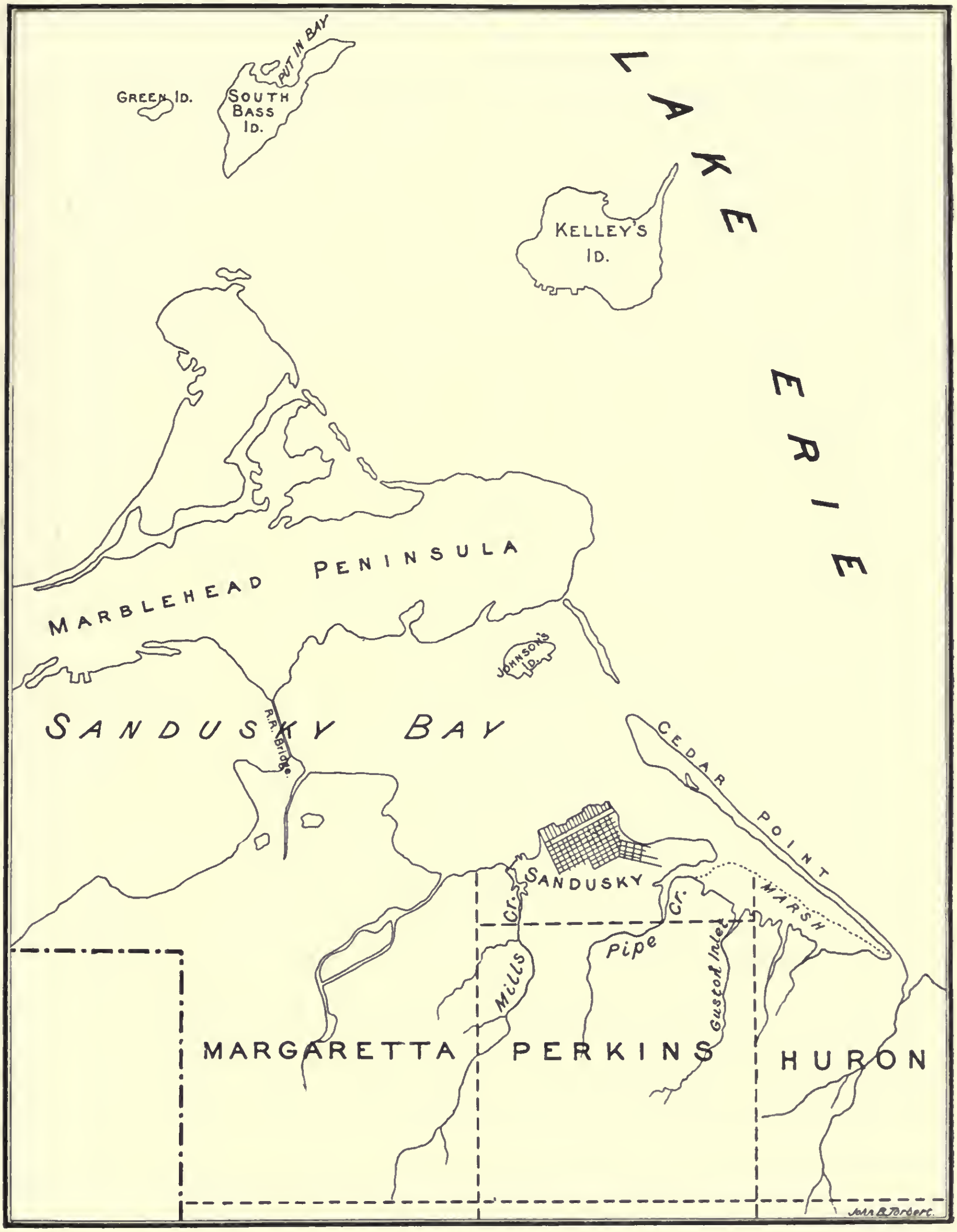

Figure 3.—Sandusky and Vicinity

bay is nearly level, so that soundings giving the depth of the water do not disclose any valleys. By testing the bottom at numerous points along lines transverse to the general course of the stream, it was found that off the mouth of each stream was soft mud containing organic matter and readily distinguished from the glacial drift on either side. It had been thought that the glacial clay might be softened by being covered by water so long, but experience showed that as a rule the weight of two men would push the auger but a few inches or a foot or two into this clay, whereas it might be pushed 20 feet or more into the deposits made since the glacier. The agitation of the water by waves has caused the loose mud to fill the original valleys, making the bottom of the bay approximately level. These valleys, made by the streams when they flowed miles farther than now to reach the lake, are thus traceable by the lines of soft mud.

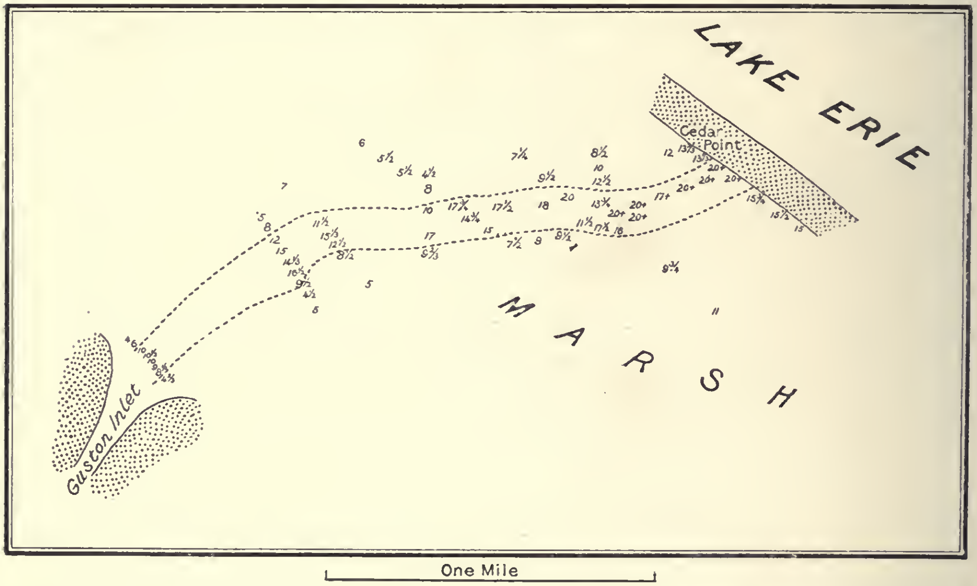

Figure 4.—Valley Extending Under Marsh from Guston Inlet to Cedar Point

Figure 1 shows a cross-section of the valley of Mills Creek, three-eighths of a mile out from the present mouth.

Figure 2 shows the depth in feet to clay in the part of Sandusky Bay extending north from the mouth of Mills Creek a distance of 2 miles. To avoid crowding, some of the numbers have been omitted. Along line A were made 41 holes 8 rods apart. Excepting near the western end, they show the clay to be everywhere 6 to 8 feet below the surface—such uniformity as to indicate that the original inequalities were planed off by wave action. Line B, parallel to A and almost 2 miles long, shows nearly as much uniformity. From the place of deep mud on line A a line of deep mud extends to the present mouth of Mills Creek and in the opposite direction to the line of deep mud that marks the former course of the Sandusky River.

The valleys of two streams east of the city, Pipe Creek and Guston Inlet, one in the open bay and one in the marsh (see figure 3), have been traced across to Cedar Point and the valleys of five other streams entering the bay or marsh traced for short distances or intersected by lines of holes at one or more places. The submerged valley of Sandusky River, which empties into the west end of the bay, was intersected by six north and south lines. It reaches a depth of more than 40 feet before entering the lake.

The valley extending under the marsh from Guston Inlet to Cedar Point was one of the easiest to trace. Along the belt indicated on figure 4, not much wider than the valley of the brook before it enters the marsh, 35 holes were made through the muck. At all of them the hard bottom is deeper than at the nearest holes outside the lines. The present channels through the marsh do not follow the buried valleys.

In the deeper parts of these valleys in the marsh the auger penetrates 20 feet of organic matter, and with an extension piece this would doubtless be found to extend several feet lower. In the open bay the valleys are filled with mud, the lower portion of which contains an abundance of molluscan shells and vegetable matter.

In some places, even at a depth of 32 feet, the peat shows that a marsh existed there when the lake was that much lower. These buried marshes seem to indicate that the depression of the land has not been interrupted by any periods of elevation sufficient to allow the streams to carry away the remains of the marsh vegetation.

In attempting to trace the valley of Mills Creek I found a small valley north of Sandusky which I supposed for some time to connect with Mills Creek, but which proved to be an extension of a little stream that formerly flowed through the city, whose water was long ago diverted to sewers. Along its course the streets had been graded and the yards filled, so that probably very few, excepting the older residents, knew that a natural stream once flowed past their premises.

The discovery of these submerged valleys in Sandusky Bay is an additional verification of the theory that the post-glacial tilting of the Great Lake basins has not yet ceased.

PLACE NAMES OF THE UNITED STATES

THE origin of some ten thousand place names in the United States is given in a recent bulletin by Mr Henry Gannett, published by the U. S. Geological Survey. The names are well distributed throughout the country. The author, in his preface, disclaims universal accuracy, but hopes that the work may arouse interest and criticism, so that all possible information on the subject may be obtained and published in a later edition. There is much difference of opinion about the origin of many names, as the following extracts from the bulletin well illustrate :

Chicago ; city and river in Illinois. The origin of the word is from the Indian, being a derivation by elision and French annotation from the word Chi-kaug-ong. Col. Samuel A. Starrow used the name in a letter to Gen. Jacob Brown, in 1816, as follows : "The River Chicago (or in the English, Wild Onion River)." Schoolcraft in 1820 said: "Its banks . . . stated to produce abundantly . . . the wild species of cepa or leek." Bishop Baraga gives : "From Chicag, or Sikag, 'skunk,' a kind of wild cat." John Turner defines skunk as she-gahg ; onion, she-gau-ga-winzhe, "skunk weed." When the word first appeared the country was inhabited by a tribe of Miamis, in whose dialect the word for skunk was "se-kaw-kwaw." It is said that the wild cat, or skunk, was named from the plant.

Coney; island at the extremity of Long Island, New York, which is said by some to have been so named because of the numbers of rabbits there. Another theory ascribes it to the winds having driven the sand into truncated cones. It appears, however, to have been originally called Congu, which may suggest another derivation

Chesapeake; bay in Maryland which gives name to several places in the country. An Indian name variously explained. Heckewelder says it is corrupted from Tschischwapeki, which is compounded of kitshi, "highly salted," and peek, "a body of standing water, a pond, a bay." Others give che, "great," and sepi, "waters." Bosman interprets it as "mother of waters." W. W. Tooker says that the early form was Chesepiooc, from k'che-sepi-ack, "country on a great river."

California; one of the states of the Union. This name was applied by Cortez to the bay and country, which he supposed to be an island. The name is that of an island in an old Spanish romance, where a great abundance of precious stones were found. Eight post-offices bear this name.

Canada; villages in Marion County, Kansas; Pike County, Kentucky, and Muskegon County, Michigan, named from the Dominion of Canada. Authorities differ as to the derivation of this name. Father Hennepin says the Spaniards were the original discoverers of the country, but upon landing they were disappointed in the general appearance, and expressed their feelings by saying, "Il capa di nada," "Cape Nothing." Sir John Barlow says the Portuguese, who first ascended the St. Lawrence, believing it to be a passage to the Indian Sea, expressed their disappointment when they discovered their mistake by saying "Canada," "Nothing here." This the natives are said to have remembered and repeated to the Europeans who arrived later, who thought it must be the name of the country. Dr Shea says the Spanish derivation is fictitious. Some think it was named for the first man to plant a colony of French in the country, Monsieur Cana. Charlevoix says the word originated with the Iroquois Indians, Kanata, or Kanada, "a collection of huts, a village, a town," which the early explorers mistook for the name of the country. Other etymologies propose the two Indian words, Kan, "a mouth," and ada, "a country;" hence "the mouth of the country," originally applied to the mouth of the St. Lawrence. There is a respectable authority that the name was first applied to the river. Lescarbot tells us that the Gasperians and Indians who dwelt on the borders of the Bay of Chaleur called themselves Canadaquea; that the word meant "province or country." Sweetser says that the word came from the Indian Caughnawaugh, "the village of the rapids." Brant, the Indian chieftain, who translated the gospel into his own language, used the word canada for "village."

Chautauqua; county in Kansas; county, lake, and town in New York. An Indian word which has been the subject of much controversy. Webster says it is a corruption of a word which means "foggy place." Another derivation gives the meaning as "bag tied in the middle," referring to the shape of the lake. It is also said to mean "place where a child was washed away." Dr Peter Wilson, an educated Seneca, says it is literally "where the fish was taken out." Other meanings given are "place of easy death," "place where one was lost."

Brandywine; creek in Pennsylvania.

According to a tradition, the name is derived from the occasion of a vessel laden with brantewein (brandy), which was lost in its waters. Other authorities derive it from Andrew Braindwine, who owned lands near its mouth in early days. A third theory is that the slough near Downington discharged its muddy waters into the creek, tinging it the color of brandy. A celebrated battle was fought there, which accounts for the name being given to eight places in the country.

Des Moines; river, county, and city in Iowa. This name is thought to have been derived from the Indian word mikonang, meaning "the road." This name was applied by the Indians to a place in the form of Moingona, which the French shortened into Moin, calling the river "rivière des moins." Finally the name became associated with the Trappist monks, and the river by a spurious etymology was called "la rivière des moines," "the river of the monks."

Laramie; county and city in Laramie County, Wyoming, named for Jacques Laramie, a French trapper.

San Francisco; bay, county, and city in same county, in California, said by some to have been named for the old Spanish mission of San Francisco de Assisi; by others to have been named for the founder of the order to which Father Junipero, the discoverer of the bay, belonged.

Delaware; river, state, counties in Indiana, Iowa, New York, Ohio, and Pennsylvania, named for Lord de la Warr, governor and first captain-general of Virginia. Many small places also bear this name. A tribe of Indians were known by this name, and in the case of the county in Indiana, the name was given because this tribe had villages within the boundaries of the county.

Niagara; county in New York and river between Lake Erie and Lake Ontario. An Indian word meaning "across the neck or strait," or "at the neck."

Shenandoah; county and river in Virginia, city in Page County, Iowa, borough in Schuylkill County, Pennsylvania, and town in Page County, Virginia. An Indian word said by some to mean "the sprucy stream;" by others, "a river flowing alongside of high hills and mountains;" and still another authority states that it means "daughter of the stars."

Massachusetts; one of the thirteen original states. An Indian word meaning "at or near the great hills." According to other authorities, "the hill in the shape of an arrow-head," "great hill mouth," "the blue hills."

Montana; state in the Union. A Latin word meaning "mountainous region," and applicable to this State on account of the nature of its topography.

Mississippi; state of the Union, counties in Arkansas and Missouri, and river, one of the largest in the United States. An Indian word meaning "great water" or "gathering in of all the waters" and "an almost endless river spread out."

AMONG THE GREAT HIMALAYAN GLACIERS

DR WILLIAM HUNTER WORKMAN and Mrs Fanny Bullock Workman, life members of the National Geographic Society, have returned to India from their third expedition into the higher Karakoram Himalayas. The object of their last journey was the exploration of the great Chogo Lungma Glacier in Baltistan. This they successfully accomplished, following the glacier to its source, 30 miles northwest of the village of Arandu, and also throughout their whole course three of its large terminal tributaries. In all, 55 miles of glacier were examined. This is the first time the upper half of this glacier and its branches have been visited. Its delineation on the maps was found entirely incorrect and mostly the work of imagination.

The Chogo Lungma ascends from its end to its point of origin over 9,000 feet, exceeding in this respect by 3,000 feet the Biafo Glacier, explored by the same parties in 1899. It takes its rise in a wall of ice and snow, the top of which is 20,000 feet, connecting two high peaks, one of which has been fixed by the Indian Survey at 24,486 feet, and the other is not much lower.

Its upper part takes one among a group of mountain *massifs*, several of which reach heights of over 24,000 feet, in the highest degree beautiful, majestic, and impressive. Its surface is much broken. In many parts wide crevasses seam it in every direction, huge séracs of curious and varied forms shag it, and in the higher portions ice falls tax the skill of the explorer to find a way through and around them.

The glacier bears several large medial moraines 80 to 100 feet high, contributed by the terminal branches. A deep depression at one point is occupied by a good-sized lake. Impassable ice falls occur in most of the tributary glaciers. The gradient is gentle except for the last few miles, where it is sharp.

One of the branch glaciers leads to a broad ice pass at a height of 17,500 feet, beneath the northern slopes of Mt. Haramosh, 24,285 feet, whence another glacier plunges rapidly downward to valleys leading to the Indus.

First ascents were made of four peaks and two cols. One of the last, a wall of ice covered with snow rising at angles of 45° to 60°, afforded a climb of exceptional alpine difficulty. Every step had to be cut from 6 a. m. to 1.30 p. m., when the crowning ridge, something over 19,000 feet, was reached. The descent was more difficult and dangerous than the ascent, owing to the softening of the covering layer of snow by the burning sun.

The weather was unfavorable most of the time. Scarcely two days in succession were clear. Much new soft snow was met with in the higher parts of all the glaciers, rendering progress slow and difficult. The depth at one point measured 34 inches, which was a fair average over considerable distances covered. The party was detained at one high camp sixty hours by a severe snow-storm.

Many days and nights were passed at high snow camps at altitudes of 16,000 to over 19,000 feet. Stone cairns were built at points where the material for building them existed, in which records were left.

To the three altitude records made by Mrs Bullock Workman on the last expedition, the highest being 21,000 feet, she has now added a fourth, being the only woman who has made the first ascent of one of the great Himalayan glaciers or any other of equal size.

The thanks of the explorers are due to the English officials at Srinagar for moral and material aid in obtaining transport, and to His Highness the Maharaja of Kashmir and his brother, Gen. Raja Sir Amar Singh, who took a friendly interest in the expedition, ordering all officials along the route taken to provide coolies and supplies and render any other needful assistance.

Dr Karl Oestreich, of Frankfurt, accompanied the expedition as topographer and Mattia Zurbriggen and Muller Giuseppi as guides. Many photographs were secured.

F. B. W.

GEOGRAPHIC NOTES

U. S. SIGNAL CORPS

THE phenomenal progress of the U. S. Signal Corps in binding together and unifying the distant possessions of the United States, the Philippine Islands and Alaska, is strikingly emphasized by figures given in the report of Gen. A. W. Greely, U. S. A., for the last fiscal year. During the year the telegraph system in the Philippines was increased by 2,600 miles. There are now 6,434 miles of telegraph and cable lines in the islands. Of this aggregate 1,326 miles are submarine cable lines and 6,434 land lines. Every mile of these lines has been laid by the Signal Corps in four years. Perhaps even more remarkable than the splendid work in the Philippines are the achievements of the corps in Alaska, where in two seasons 1,121 miles of land lines and submarine cables have been laid. This work not only included the surveying and the construction of the line, but also meant the transportation of hundreds of tons of material, instruments, etc., over distances varying from 4,000 to 7,000 miles. "The toil and hardship experienced cannot be fairly appreciated by any one unfamiliar with Alaskan trails. Suffice it to say that every pound of forage, tentage, etc., wire, insulators, or line material has to be moved by pack animals over a trail so rough that an animal can hardly travel fifteen miles a day." A message from Fort St. Michael, opposite Nome, can now be wired to Skagway by an all-American line, and from Skagway forwarded by the Canadian line between Dawson and Ashcroft to the United States.

During the year the Signal Corps turned over to the Cuban Government 3,500 miles of wire and equipment, which General Greely's men had put in during the American occupation. Of this work General Greely says:

"It is unquestioned that on occupying Cuba the American army found a few dilapidated telegraph lines, operated by antiquated methods, with tariff rates increasing in proportion to the length of the message, without free delivery, and with grave uncertainties as to espionage, secrecy, and delivery. This system, bad as it was, served only the western half of the island. In leaving Cuba there was turned over to the government a system of 3,500 miles, extending from San y Martinez, in the west, to Cape May, in the extreme east, with every seaport or town of importance electrically connected. The present instruments are of the best modern types, the transmission speedy and reliable, and the tariff rates exceedingly low, while the certainty of delivery and inviolability of messages are beyond question."

DAVID CHARLES BELL.

DR DAVID CHARLES BELL, one of the first members of the National Geographic Society, died at his home in Washington, October 28, 1902, in his eighty-sixth year. Dr Bell was a noted educator and Shakespearean scholar. Among his writings are: A "Reader's Shakespeare," in three volumes; "The Theory of Elocution"; "Modern Reader and Speaker," and "The Standard Elocutionist." His "Speaker" for nearly fifty years has been a standard work in the colleges and universities of England and America. Twenty editions of the volume have been published. Mr Bell was born in St. Andrews, Scotland, in 1817. After some years of study at the University of Edinburgh, he became professor of English literature at Dublin University. In 1875 he came to America, first settling in Canada, and later, in 1883, moving to Washington, D. C.

RUSSIAN AND AMERICAN PETROLEUM

THE Division of Mineral Resources of the Geological Survey has published some interesting figures comparing the Russian and American production of petroleum and showing the extent to which oil is used in Russia as fuel.

Since the year 1897 Russia has produced more petroleum than the United States. Beginning with 1897, the Russian production has been increasing by an average of over 12 per cent each year to the close of 1901. In round numbers, the figures of production for the two countries are as follows: 1897—Russia, 54,000,000 barrels; United States, 60,000,000 barrels. 1898—Russia, 62,000,000 barrels; United States, 55,000,000 barrels. 1899—Russia, 66,000,000 barrels; United States, 57,000,000 barrels. 1900—Russia, 76,000,000 barrels; United States, 64,000,000 barrels. 1901—Russia, 85,000,000 barrels; United States, 69,000,000 barrels. The average annual increase during the five years for Russia has been 12.57 per cent; for the United States, 2.89 per cent, there having been a small decrease in the production of the United States in 1897 and a large decrease in 1898.

The facilities for handling the large Russian production are at present crude, costly, and wasteful. The markets are far away from the production. The main foreign shipping port at Batum, on the Black Sea, is separated by mountain chains from the chief center of production (Baku) on the Caspian Sea. To reach Batum the oil must run 160 miles through pipes and then be carried 400 miles by railroad. Four-fifths of the Russian oil is carried in boats up the Volga River into the heart of European Russia. At least two-thirds of the Russian oil is used for fuel.

The total exports of petroleum, crude and refined, from Russia to foreign ports in 1901 were 428,657,210 gallons. This was less than one-half the total exports of petroleum from the United States in 1901, which amounted to 1,062,750,306 gallons, valued at nearly $71,500,000.

The very great difference between the petroleum of the United States and that of Russia is shown in the statistics of refined petroleum. Of the total world's production of crude petroleum in 1901, 165,385,733 barrels, the United States produced 69,389,194 barrels, or 41.97 per cent, and Russia produced 85,168,556 barrels, or 51.49 per cent; and yet of the total production of refined petroleum of all grades in 1901, estimated at 1,500,000,000 gallons for all countries, the United States produced 911,120,944 gallons, or 60.7 per cent, and Russia 414,122,990 gallons, or only 27.7 per cent.

GEOGRAPHICAL SOCIETY OF BALTIMORE

ON October 17 a number of scientific gentlemen and of those interested in geographic science met in Baltimore at the home of Dr D. C. Gilman and organized the "Geographical Society of Baltimore." The aim of the society is the promotion and diffusion of geographical knowledge, more particularly of that which is of commercial importance to Baltimore. Vice-President W J McGee, LL. D., represented the National Geographic Society and extended its congratulations and well wishes to the new organization. Dr Gilman, who is also one of the Board of Managers of the National Geographic Society, was chosen first President and the following officers and trustees were elected:

First Vice-President—Mr Bernard N. Baker.

Second Vice-President—Rev. Dr John F. Goucher.

Third Vice-President—Gen. Lawrason Riggs.

Treasurer—Mr Robert Garrett.

Secretary—Dr George B. Shattuck.

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DECISIONS OF THE U. S. BOARD ON GEOGRAPHIC NAMES

October 1, 1902

Blackman; stream flowing from Chemo Pond, Penobscot County, Maine (not Chemo nor Nichols).

Calabasas; arroyo, peak, post-office, and township, Los Angeles County, California (not Calabazas nor Calabaces).

Chaparral; gulch, post-office, and railroad station, Yavapai County, Arizona (not Chaparal).

Chemo; pond, Penobscot County, Maine (not Nichols).

Chestatee; militia district (Lumpkin County), and river, Georgia (not Chostatee nor Chosteta).

Chocowinity; bay, creek, post-office, and township, Beaufort County, North Carolina (not Chockowinity)

Conetoe; creek in Edgecombe and Pitt Counties, post-office, railroad station, and two townships (Upper and Lower) in Edgecombe County, New York (not Coneeto, Coneto, Congeto, nor Keneighton).

Conoho; creek, post-office, railroad station, and village, Martin County, North Carolina (not Coniho nor Goose Nest).

Elkahatchee; creek in Coosa and Tallapoosa Counties, Alabama (not Elkehatchee nor Elkhatchee).

Indian Guyan; creek in Gallia and Lawrence Counties, Ohio (not Guyandotte nor Indian Guyandotte).

Lattintown; post-office in Marlboro, Ulster County, New York (not Lattingtown nor Latintown).

Malibu; creek, land grant, and point, Los Angeles County, California (not Malaga, Malibo, Topanga Maliba Sequit, nor Topanga Malibu Sequit).

Padelford; creek, post-office, railroad station, and village in Canandaigua township, Ontario County, New York (not Paddlefords).

Powells; post-office and railroad station, Marion County, West Virginia (not Powell)

Roquist; creek and pocoson (swamp), Bertie County, North Carolina (not Rocquist, Roquest, Roquewhist, nor Rakwis).

NOTE—From the Catawba word "rakwis," meaning turtle.

Rosier; cape, Penobscot Bay, Hancock County, Maine (not Rozier).

Siquis; arroyo or creek, Los Angeles County, California (not Isique, Sequit, nor Siquit).

Soque; post-office and river, Habersham County, Georgia (not Sookee nor Soquee).

Stevenston; post-office and railroad station, Warrick County, Indiana (not Stephenson, Stephenston, Stevans, nor Stevens).

Named after Judge Stevens.

Swarte; hill, Ulster County, New York (not Black, Crosiers, Swarts, nor Swartz).

Symmes; creek, Gallia and Lawrence Counties, Ohio (not Simms).

Tesnatee; creek, gap, militia district, and post-office, White County, Georgia (not Tesnata nor Tessantee).

Topanga; canyon, Los Angeles County, California (not Tobanao, Tobanca, nor Topango).

Tranters; creek, forming part of boundaries of Beaufort, Martin, and Pitt Counties, North Carolina (not Trantus).

Unicoi; gap and turnpike, White and Towns Counties, Georgia (not Unicoy).

Census of the Philippines.—Mr. Henry Gannett is on his way to Manila to assume expert statistical charge of the approaching census of the islands.

Mt. Foraker.—Careful measurement by the Brooks party in Alaska the past season showed that Mt. Foraker, the twin peak of Mt. McKinley, is about 17,000 feet high instead of 20,000.

The completion of the cable between Canada and Australia was celebrated on October 31, when the first eastward message was sent from Wellington, New Zealand. It was a message of congratulation from the premier of New Zealand to Sir Sanford Fleming, of Ottawa, as follows:

"Delighted to congratulate you on completion of great work of Pacific cable, thus rewarding your interest and labor in forging further link to advantage of our empire.

"SEDDON, *Premier*."

A bulletin soon to be issued by the United States Geological Survey contains a report by Dr C. W. Hayes and Mr William Kennedy on the Texas-Louisiana Oil Field, which is of particular interest at this time.

NOTE FROM DR GEORGE DAVIDSON

THE Geographical Society of the Pacific has fallen heir to the sum of five thousand dollars by the bequest of the late Mr John Dolbeer, of San Francisco. Mr Dolbeer had been one of the directors of the Society for many years, and had always taken a lively interest in geographic work, especially in all that related to the countries bordering the Pacific or contiguous thereto.

GEORGE DAVIDSON.

SAN FRANCISCO, CAL.,
October 16, 1902.

GEOGRAPHIC LITERATURE

Through Hidden Shensi. By Francis H. Nichols. Illustrated by photographs taken by the author. Chas. Scribner's Sons. New York, 1902. $3.50 *net.*

Eight hundred miles southwest of Pekin lies the province of Shensi. Its area is greater than that of England and Scotland combined. Its people are so isolated that the people of Pekin speak of the province as though it were a foreign country. Several years ago a famine ravaged the province, and the people of the United States, at the appeal of the *Christian Herald*, of New York, sent a fund for the sufferers. Mr Frank H. Nichols, acting as agent for the fund, went to Shensi to distribute the relief and report on the famine. "*Through Hidden Shensi*" is an interesting account of his experiences. The volume is very well written and shows that the author is an observing traveler, one who appreciated and was in turn liked and respected by the people among whom he journeyed.

The White World. Life and adventures within the Arctic Circle portrayed by famous living explorers. Collected and arranged for the Arctic Club by Rudolf Kersting. Illustrated. New York: Lewis, Scribner & Co. 1902. $2.00 *net.*

The author has brought together in this volume some twenty or more remarkable descriptions of arctic life. Admiral Schley contributes the opening chapter—a thrilling story of the rescue of Greely's heroic survivors. Amos Bonsall, the only survivor of the famous Kane expedition of 1853–1855, compares present methods of arctic exploration with those of fifty years ago. Three members of Greely's expedition, Major Brainard, Henry Biederbick, and Francis Long, contribute respectively chapters on "Farthest North with Greely," "Polar Hospitals," and an "Arctic Bear Hunt." The wildest romance of Hope or Weyman is tame beside the grim tragedy of the Greely expedition as partly told by these three heroes.

"Lost on the Ice Cap," by Hugh J. Lee, a member of Peary's expedition of 1893–'94, is the author's experience of being lost on the ice cap in winter and wandering two nights and one day without food before regaining camp. It is a story of fortitude and pluck that has few equals.

But "The White World" has its more cheerful chapters as well. Mrs. F. L. Lee contributes "An Arctic Honeymoon;" Albert Operti several pages on "An Artist in the Frozen North;" the editor, Rudolf Kersting, a chapter on "Photography in the Far North," and Robert Stein something about Eskimo music.

Vienna and the Viennese. By Marie Homer Lousdale. Illustrated. Philadelphia: Henry T. Coates & Co. 1902.

Miss Lousdale is the author of "Scotland—Historic and Romantic," published by the same firm several months ago. From her latest work one obtains an admirable impression of what Vienna is like. Many anecdotes are told about the famous statesmen and emperors who for centuries made history at the great capital. The volume will be specially interesting to those who have been fortunate enough to have visited the city.

Mineral Resources of the United States, Calendar Year 1901. By David T. Day. Washington: U. S. Geological Survey. 1902.

This valuable volume contains a series of interesting reports by experts on the development of the mineral industries of the United States in 1901. The value of our mineral productions during that year exceeded one billion dollars for the second time in our history. The "Introduction and Summary" are by Dr David T. Day; the reports on Iron Ores and Manganese Ores by John Birkinbine; Statistics of American Iron Trade, by James M. Swank; Copper, Lead, Zinc, by Charles Kirchoff; Gold and Silver, by George E. Roberts; Aluminum, Platinum, etc., by Joseph Struthers; Coal and Coke, by E. W. Parker; Petroleum and Natural Gas, by F. H. Oliphant; Precious Stones, by George F. Kunz; Mica, Asbestos, etc., by Joseph Hyde Pratt; Ores of Economic Importance, by E. O. Hovey.

Picturesque Sicily. By William Agnew Paton. Illustrated. New York and London: Harper & Bros. 1902.

This is a new and revised edition of a work first published in 1897. It is mainly a description of the picturesque island as it is today, but the author does not forget the historical interest which clings to every town and hamlet in the island that for centuries was the battlefield of the Greek, the Carthaginian, the Roman, the Saracen, and the Norman. Some unusually fine pictures illustrate the text.

Stanford's Compendium of Geography. Vol. I: South America. Vol. II: Central America and West Indies. With many maps and illustrations. By A. H. Keane. Edited by Sir Clements Markham. New York. 1901.

Useful and interesting information is contained in these two volumes. For a general knowledge of South and Central American resources and geography, one could not do better than consult them. In the former series of Stanford's Compendium South and Central America filled the pages of only one volume, but in recent years so much more has been learned about these countries, and so much greater interest is felt in them, that the editor has now devoted two large volumes to the subject. Some excellent maps and illustrations accompany the text.

All the Russias. By Henry Norman, M. P. With 129 illustrations and four maps. New York: Chas. Scribner's Sons. 1902. $4 *net.*

Mr Norman has for many years been a student and writer on Russian subjects. He has made four separate journeys in the Russian Empire—one of nearly twenty thousand miles. His observations and conclusions therefore deserve much consideration. The more interesting portions of the present volume deal with Finland, Siberia, and the economics and foreign politics of the government.

Of special interest to Americans is the chapter on "Russia and England." Mr Norman does not share the common belief that a death struggle between England and Russia is destined in the more or less remote future. "I am profoundly convinced," he says, "that a good and lasting understanding between the two nations is not only desirable above all things, but also well within the range of possibility." Three obstacles exist to a good understanding—China, India, and Persia. In China Russia has won what she wanted, the control of Manchuria and Mongolia, and Mr Norman is not sure but she has undertaken a responsibility the end of which has not come. The danger of India, where the real strain between the British and Russian interests lies, the author considers much exaggerated. "I have endeavored to study every fact bearing upon it [Russia's intentions with regard to India], and after long consideration I have come to the conclusion that the colossal and perilous undertaking of an armed invasion of India, with a view to conquest, is not part of the plan of any really responsible Russian, either statesman or soldier. . . . I sincerely believe the most influential of all would not have India as a gift. . . . The truth is, in my opinion, that Russia regards her position on the Indian frontier as a lever to bring pressure to bear, whenever necessary, upon England in other matters. . . . But the notion of invading India to annex and administer it does not seriously exist in Russia."

Russia's ambition in Persia is not directed against England, but is a struggle for air, for sea outlets. Persia is now financially a vassal of Russia, who will soon have her ports on the Persian Gulf. Captain Mahan, Lord Curzon, and English statesmen have declared that Russian ports on the Persian Gulf will seriously menace the Suez route to India and the Far East and would endanger British power in Asia. But Mr Norman argues that Russian occupation of the Persian seacoast would simply make it necessary for England to strengthen her Indian fleet and build a branch railway or two to the northwestern frontier. Mr Norman concludes the chapter with the following sentences: "We may await with comparative equanimity the development of a *rapprochement* based upon geography and history, upon sentiment and upon interest. I believe it will come in time; if not today, then tomorrow."

Glimpses of China and Chinese Homes. By Edward S. Morse. Illustrated from sketches in the author's journal. Boston: Little, Brown & Co. 1902. $1.50 *net.*

So many books relating to China have been published during the last few years that it is impossible to read them all, and one even wonders if there is anything more about this mysterious land and people that can be said. In the present work, however, Professor Morse presents many quaint descriptions and unusual pen-and-ink sketches, in which new glimpses of Chinese homes are given. The author carried his sketch book wherever he went and was wont to sketch hastily what he saw. He has thus been able to depict very clearly the every day life of the Chinaman's household.

International Year Book for 1901. Editor, Frank Moore Colby. With maps and illustrations. New York: Dodd, Mead & Co.

This annual volume is planned as a cyclopedia of general information about those places, persons, and subjects which attain prominence during the year. The Year Book for 1901 is the most comprehensive that has yet been published, and reflects much credit on the editor, Mr. Colby. There are good reviews of arctic and antarctic exploration of 1901, accompanied by excellent maps; of American progress in the Philippines, of archæological discoveries in Babylonia, Egypt, Greece, and in the United States. A valuable feature are articles on the industries of the United States in 1901. As a work of reference, the Year Book is indispensable.

The Home Life of the Borneo Head-Hunters. By William Henry Furness. Illustrated. Philadelphia: J. P. Lippincott Co. 1902. $7.50 *net.*

One hundred magnificent full-page illustrations, most of them from photographs taken by the author, describe in most graphic manner the life, looks, and customs of this far-off people. One picture shows a war and racing canoe, 120 feet long and cut out of a single log, in which are seated, without crowding, 100 warriors. Mr Furness' narrative of his life among the head-hunters is, however, no less interesting than the pictures he brought back with him.

He found human nature the same in Borneo as in the United States. "The youths have their languishing loves, which they are eager to confide to sympathetic ears. . . . The Bornean mothers and fathers think their babies the prettiest that ever were born." After a month is passed in a kayou or kenyah house, "the host and hostess, who, on first sight, seemed to be uncouth savages, frightfully mutilated as to eyes, ears, and teeth, are regarded as kind-hearted, devoted friends. It becomes well-nigh impossible to realize that they cannot add the simplest of sums without the aid of fingers and toes."

Japan and Her People. By Anna C. Hartshorne. Illustrated. 2 vols. Philadelphia: Henry C. Coates & Co. 1902.

These two volumes on Japan are of a series which Messrs Coates & Co. are publishing descriptive of different countries and cities. Like all in the series, the present volumes are written in an entertaining popular style and are handsomely illustrated with photogravures. Into her descriptions of noted buildings and scenes the author has woven the romances that the people believe and tell about the places. The work can hardly be called original or described as showing much research, but perhaps for that very reason will appeal to a larger number of travelers and readers.

Historical Sources in Schools. Report to the New England History Teachers' Association. By a select committee — Charles D. Hazen, chairman—and Professors Bourne, Dean, Farrand, and Hart. New York: The Macmillan Co. 1902. 60c.

The aim of this book is excellent—to present a bibliography of such original documents as are easily obtained, in order that history may be studied at its first source, and not as interpreted by others in books.

The committee have done their task excellently and prepared a large list of original documents. It would be well, however, in a second edition of the work to include some of the personal narratives of. the great explorers, Marco Polo, Columbus, Cook, Livingstone, Stanley, and others, some of whom set in motion political forces that changed the course of history.

THE NATIONAL GEOGRAPHIC SOCIETY

During the season of 1902–1903 the National Geographic Society presents in Washington, D. C , three courses of meetings—Popular Lectures, Technical Meetings, and Lenten Lectures. These courses have been planned with great care to include those problems of a geographic character which are of special interest to the general public at the present time. Arrangements have been made for addresses in the Popular Course on the geographic distribution and mining of hard and soft coal, Mr Peary's work in the Arctics during the last four years, the tragedy of Saint Pierre, Colombia and the Isthmian Canal, the commercial expansion of Argentina, and the Macedonian question.. The arrangements for the later part of the season are so far provisional as to permit the introduction of specially timely topics

The interest shown last year in the Technical Meetings, which were planned for scientific men actively engaged in geographic work and for persons specially interested in such work, has led the Board to continue such meetings.

The subject of the Afternoon, or Lenten, Course will be announced in a later program.

REGULAR MEETINGS

of the Society for the presentation of technical papers and discussion will be held on Friday evenings, at 8 o'clock, commencing November 7, and alternating with the Popular Lectures. As the new home of the Society will not be completed before January 15, 1903, these meetings will be held for the present in the Assembly Hall of the Cosmos Club The course has been planned to form a series on the geographic work of the great scientific bureaus of the government. Mr Richard U. Goode, Chairman of the Committee on Technical Meetings, announces the following program:

November 7.—"Some of the Administrative and Industrial Problems of Porto Rico." Hon. Wm. F. Willoughby, Treasurer of Porto Rico.

November 21.—"The work of the U. S Coast and Geodetic Survey " Hon. O. H. Tittmann, Superintendent of U. S. Coast and Geodetic Survey.

December 5.—"The Work of the U. S. Weather Bureau." Dr Willis L. Moore, Chief of U. S. Weather Bureau.

December 19.—"The U. S. Signal Corps." Gen. A. W. Greely, Chief Signal Officer, U. S. A.

At later meetings the geographic work of the Hydrographic Office of the Navy Department, of the Experiment Stations of the Agricultural Department, of the Census Office, of the Naval Observatory, of the Geological Survey, and of the Library of Congress will be discussed.

THE POPULAR COURSE

will be delivered in the National Rifles Armory, G street between Ninth and Tenth streets northwest, on Friday evenings, at 8 o'clock, commencing November 14 and alternating with the Technical Meetings, which will be held in the Assembly Hall of Cosmos Club until the new home of the Society on Sixteenth and M streets is completed.

The following dates have been definitely assigned:

November 14.—"The Coal Resources of the United States." Dr David T. Day, Chief of Division of Mineral Resources, U. S. Geological Survey. (Illustrated.)

November 29.*—"Explorations in the Arctics, 1898–1902." Commander Robert E. Peary, U. S. N. (Illustrated.)

December 12.—"Argentina—Present and Future." E. L. Corthell, C. E. (Illustrated.)

January 9.—"The Turk and His Rebellious Subjects." Mr William E. Curtis. (Illustrated.)

January 23.—"The Tragedy of Saint Pierre." Mr George Kennan. (Illustrated)

Provisional arrangements have also been made for lectures on Colombia and the Isthmian Canal; America Before the Advent of Man; The Geographic Distribution of Insanity in the United States; Russia of Today (by Paul du Chaillu), and a lecture by Mr John Muir.

The Lenten Course of five lectures will be delivered in Columbia Theater, F street, near Twelfth, at 4.20 o'clock, on Wednesday afternoons of February 11, 18, 25, and March 4, 11.

The subject of this course and the speakers assigned for the special topics will be announced in a later program.

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* Please note that this lecture is Saturday evening.

Vol. XIII, No. 12 WASHINGTON December, 1902

THE NATIONAL GEOGRAPHIC MAGAZINE

VOLCANIC ERUPTIONS ON MARTINIQUE AND ST VINCENT*

By Professor Israel C. Russell

Of the National Geographic Society Expedition to West Indies

THE continuation of activity in the case of Mont Pelée and La Soufrière of St Vincent makes it evident that it is yet too early to write a final report on their recent eruptions. What may be termed a first approximation, however, to the significance of the observations concerning them already in hand,† may be of interest to the members of the National Geographic Society.

The Number of Active Craters.—The first question to which an answer is sought concerning both Mont Pelée and La Soufrière is: Have the recent eruptions occurred from a single and essentially a summit crater in each instance, or have secondary or subcraters been opened on the sides of the volcanoes, which had a connection with their conduits? In the case of La Soufrière no differences of opinion in this connection have arisen among the several observers who have visited the mountain. The eruptions have all occurred in a single crater, the so-called Old crater, in distinction from the one formed in 1812. This crater is near the summit of the mountain, but is partially encircled on the northeast by a remnant of a much older and far larger crater, which corresponds with Mont Summa at Vesuvius, and may be termed a "*somma*."

At Mont Pelée there is also a *somma*, and on its southwest side is the crater known as Étang Sec, which is now in eruption. A smaller summit crater, formerly occupied by Lac des Palmistes, occurs to the northeast of the one now active, and corresponds in a general way with the crater of 1812 on St Vincent. While several observers have reported the existence of at least two subcraters—one on the east and the other on the southwest slope of Mont Pelée, the former termed the "Falaise crater" and the latter the "Rivière Blanche crater"—a careful consideration of the evidence presented fails to show that these are true centers of eruption having deep sources. Great explosions have occurred, however, at each of the localities referred to, which have thrown large quantities of dust and mud to a height of several hundred feet, and sent out vast volumes of steam to a height of many thousands of feet; but these phenomena are seemingly the same, although marked by greater energy, as have been observed in a large number of instances on both Martinique and St Vincent, where the hot dust, lapilli, stones, etc., ejected from the summit crater, have accumulated to a great depth and been invaded by surface water. While the subcraters mentioned should not in my opinion be considered as true volcanoes, they simulate many of the phenomena attending actual eruptions from deep conduits. The columns of heavily dust- and mud-charged steam which arise from them have the convoluted or cauliflower structure, and at times expand at the top and take on mushroom shapes, in much the same manner as do the columns of steam, heavily charged with rock fragments, that are blown into the air from a primary crater. In each case the proximate cause is the same, namely, a steam explosion. The solid material blown into the air in each instance is also of the same nature (for the reason, as it seems to me, that the hot dust and stones, to which the superficial explosions are due, were supplied by the eruption of the summit crater). Since the observed phenomena are so similar, it may be asked, What is the crucial test by which a true crater may be distinguished from a pseudo-crater? To formulate a definite answer to this question is difficult. Perhaps the best reply that can be offered is that the pseudo-craters are later in the time of their appearance than the main eruptions which supplied the hot material necessary for their production, and that they occur when the topographic conditions previous to the eruptions favored the accumulation of a deep deposit of hot débris. In addition, on both Martinique and St Vincent a complete gradation in size and energy of the superficial steam explosions has been observed, ranging from small geyser-like spoutings, such as have occurred at hundreds of localities in valleys that were deeply filled with hot débris, and even on broad and comparatively smooth surfaces covered with a thick sheet of similar material, up to the markedly energetic explosions in the valleys of the Falaise and Rivière Blanche. In many instances the smaller surface explosions have been observed to follow heavy rains, and the same is true also of the larger explosions referred to. The larger explosions from the summit crater, on the other hand, are more energetic than any that can without doubt be referred to the pseudo-craters. The minor eruptions from the summit crater, however, may be due to precisely the same immediate cause as the eruptions of the pseudo-crater, namely, the access of surface water to highly heated rocks, so that an apparently complete sequence may be observed between the escape of steam from hot débris and the discharges from true volcanic conduits. It is thus seen that the discovery of the crucial test asked for is difficult, and the final decision, if one is reached, must rest on a judicial balancing of all the evidence and the weight to be given to the judgment of individual observers. An instructive fact furnished by the pseudo-crater (even when the larger and, as some persons may think, questionable examples are not considered) which has a bearing on the theories of the ultimate causes of volcanic eruptions, is the close similarity, and in fact identity, that exists between the explo-

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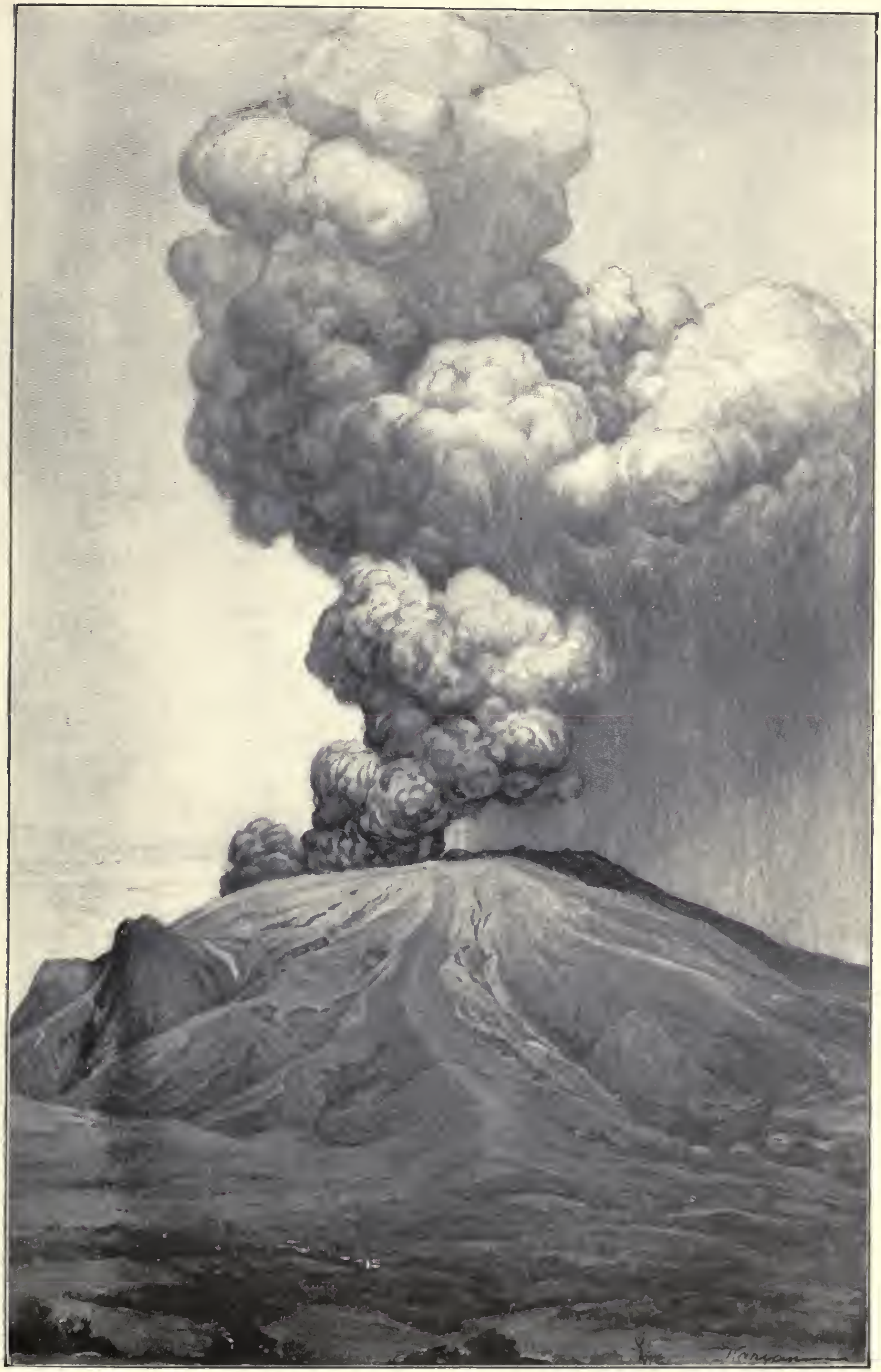
*The illustrations in this number of the West Indian volcanic phenomena, some of them republished from other reports, form a valuable supplement to the very complete and graphic set of illustrations taken by Robert T Hill and Israel C. Russell and published in the July number of the National Geographic Magazine.—Editor.

† A list of the papers referred to is presented at the end of this essay.



Mont Pelée from Vivé, May 27

The great cloud of steam and smoke rose cauliflower shaped from the summit crater to a height of from two to three miles. The descending shower of rain and ashes shows on the right

Drawn by George Varian. Republished from McClure's Magazine

The Night Eruption as Seen from the Road Going South from Vivé toward Assier

Drawn by George Varian. Republished from McClure's Magazine sions due to surface water gaining access to beds of hot débris and the explosions in the summit portions of true volcanic conduits. In the former instances surface water descends into hot rock débris; and, from the fact that water is present in the superficial portion of the earth's crust, it seems equally manifest in the latter instance that highly heated rock rises from deep within the earth and meets the surface waters. In each instance steam explosions result.

Variation in the Eruptions of the Primary Craters.—The variations presented by the steam columns which ascend from active volcanoes—of which the so-called *pine tree* of Vesuvius is a well-known example—and which in many instances afford the most spectacular of the awe-inspiring phenomena associated with them, have been described by several observers who have recently visited Martinique and St Vincent, but most graphically by George Kennan. The variations referred to are indicative of what takes place in an active crater and in the upper part of the conduit leading to it, and furnish evidence in reference to the changes there in progress. A classification of the various phases presented by the steam column rising from Mont Pelée has been presented by the gifted traveler just referred to, which is instructive.

"The vapor column ascending from Mont Pelée," writes Kennan, "varies greatly from day to day and sometimes from hour to hour, not only in density, but in color, form and general appearance. In its varying aspects it may be described as follows:

"1. The vapor of quiescence: a slowly ascending column of pure white steam, which has neither sharp, clearly defined outlines, nor puff-like convolutions, and which suggests steam rising from the hot water of a geyser basin or from the escape-pipe of a big ocean steamer."

The explanation of the account of such a column from a crater of the type of the one at the summit of Mont Pelée seems to be that the top of the lava column is well below the bottom of the crater, and that the hot rocks are discharging steam, owing to the contact with them of water percolating in from the crater walls or falling of rain. The generation of steam is a surface phenomena, and due essentially to the same cause as the escape of steam from hot débris ejected by a volcano and accumulating in valleys, etc. The notable feature is the absence of convolutions and more or less individualized fleece-like masses in the ascending column, such as are produced by small steam explosions from liquid lava, as is frequently the case at Vesuvius.

"2. The vapor of moderate activity: a column of greater density and somewhat darker color, which rolls and unfolds a little as it rises, and looks like steam mixed with brownish or yellowish smoke from the chimney of a manufactory."

This stage may reasonably be supposed to indicate conditions similar to those mentioned in the first instance, but more intense. A considerable volume of water gaining access to the deep funnel-shaped crater might not be vaporized before descending to the summit of the column of liquid or but partially congealed column of rock within the conduit, and energetic explosions result. The steam columns indicative of moderate activity thus correspond with the columns produced by the maximum explosions of pseudo-craters. The inner slope of the crater of Mont Pelée is precipitous, and, as several observers have reported, portions of its walls overhanging. The fall of blocks of rocks from the crater walls would no doubt cause a conspicuous column of dust-laden steam to ascend.

"3. The vapor of dangerous activity: a sharply defined dark-yellow column of what appears to be liquid mud,

May 30th late P.M.
From Morne Rouge.

The Smoke from the Top Crater rising on May 30 to a Height of Six Miles

Drawn by George Varian. Republished from McClure's Magazine

which boils out of the volcano in huge rounded masses, swelling and evolving in immense convolutions as it rises—one gigantic mud bubble breaking up out of another in turn—until over the crater there stands a solid opaque pillar of boiling, unfolding, evolving mud-vapor five hundred feet in diameter and eight or ten thousand feet in height.''

When such a débris-charged steam column rises from a crater there is no question as to the presence of a conduit leading down deep into the earth. The pseudo-craters seem never to reach such intensity.

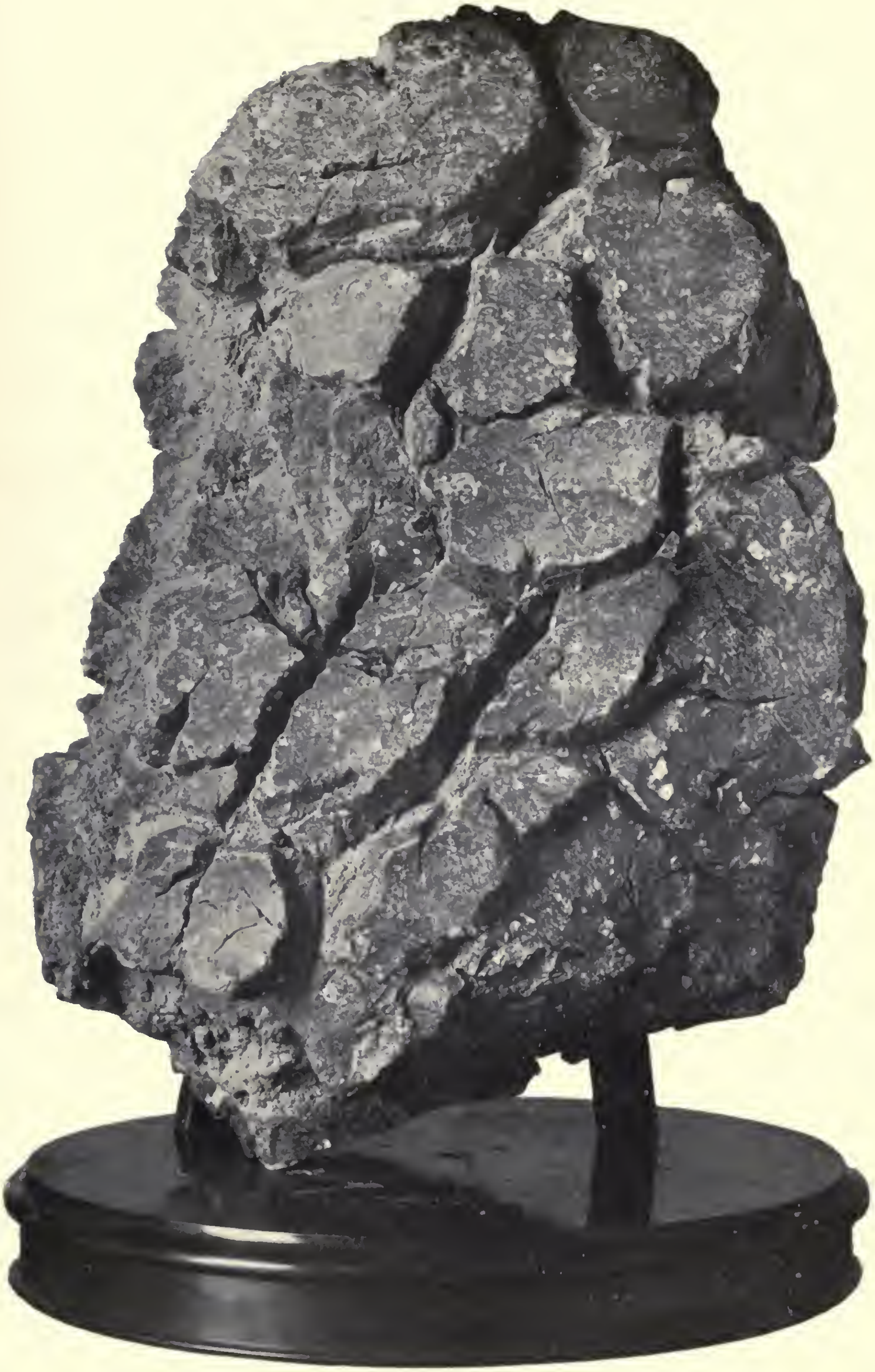
''4. The vapor of great eruptions: a straight-sided shaft of very black smoke (dust-charged steam), which shoots up out of the crater with a tremendous velocity, like the smoke of a colossal piece of artillery fired heavenward. This shaft goes to a height of fifteen or twenty thousand feet, and then mushrooms out laterally, so as to cover a circle fifty miles or more in diameter, with a volcanic canopy which is as dark as the blackest thunder cloud and which shuts out the light of day like a total eclipse. The projectile force in eruptions of this kind is so great that it throws the black vapor far above the influence of the trade winds, and the advancing edge of the volcanic mantle moves swiftly eastward two miles or more above the fleecy trade-wind clouds that are drifting in the opposite direction.''

In the making of such a column as just described the volume of water and of comminuted rock required is enormous. The volume of the column is in the neighborhood of four billion cubic feet.

If 1 per cent of the column is solid matter it equals 40,000,000 cubic feet, equals 3,000,000 tons.

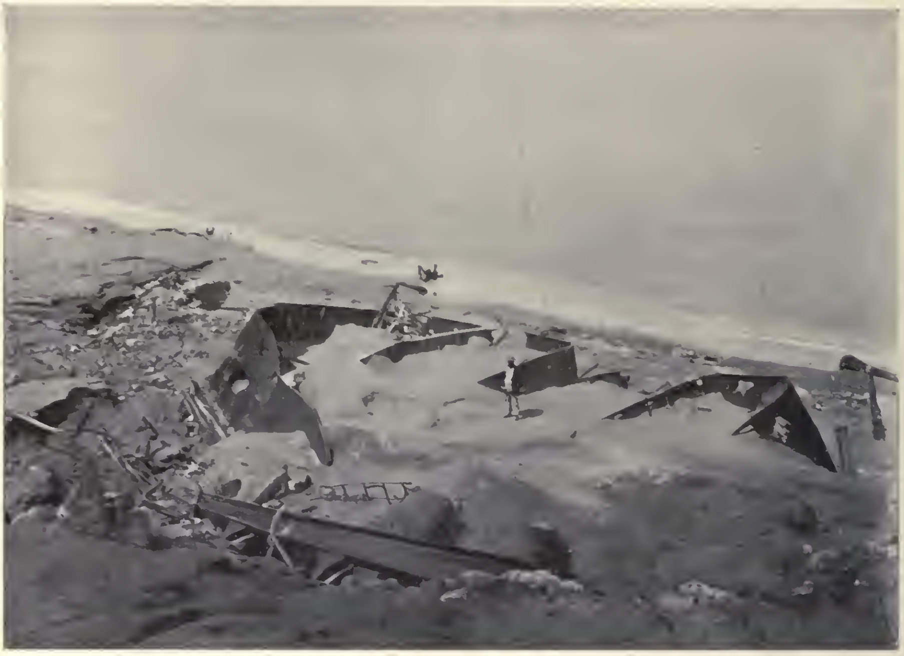
If 10 per cent of the column is solid matter it equals 400,000,000 cubic feet, equals 30,000,000 tons.

To be sure, we have no accurate measures, our information being almost entirely qualitative; but as such a column as is referred to has been observed to reach a height by estimate of 10,000 feet in two minutes, it may seemingly be safely assumed that it reached its full development in less than five minutes. The coarser of the solid matter first shot out then begins to fall, and the form of the column is maintained by new matter driven upward from the crater. Thus during each five minutes of an eruption some 4,000,000,000 cubic feet of débris-laden steam were expelled from the crater. The average duration of such eruptions is not known, but in certain instances continued for several hours. During each hour that Mont Pelée or



"Bread-Crust" Volcanic Bomb, Mt Pelée (see page 424)

Height of specimen, 2 feet 2 inches. From a photograph by Dr E. O. Hovey. Republished from the Bulletin of the American Museum of Natural History



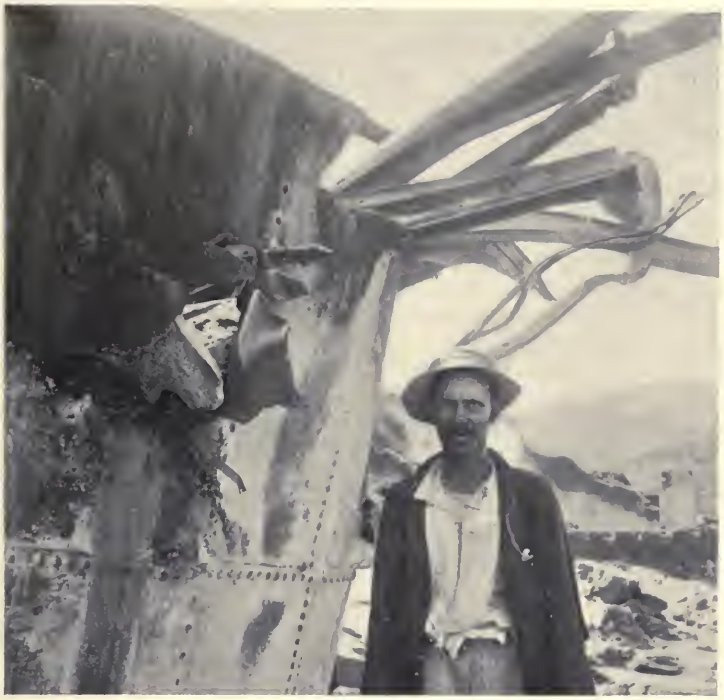
St Pierre. Ruins of the Great Distillery in the Fort Quarter of the City, Showing Holes in the Iron Tanks due to Volcanic Bombardment

From a photograph by Dr E. O. Hovey. Republished from the Bulletin of the American Museum of Natural History

La Soufrière was in full blast something like 48,000,000,000 cubic feet of dust- and stone-laden steam were driven out. Only guesses can be made as to the amount of solid matter the steam contained. Shall we assume 1 per cent or 10 per cent? Most observers would agree, I fancy, not only that the latter was nearer the truth than the former estimate, but that the true measure is in excess of the larger of the two.

The material extruded in a solid condition, as will be shown later, is fresh lava which came from deep within the earth; but mingled with it are rock fragments that were torn from the walls of the conduits through which the discharges occurred. The per cent of old lava among the ejected solids seems to be greater on St Vincent than on Martinique. In harmony with this is the larger size of the crater of La Soufrière in comparison with that of Mont Pelée.

The columns of steam of Kennan's type No. 4 thus show that great volumes of rock are rising from deep within the earth and being blown into the air. If, as seems probable, the energy displayed by steam columns of the No. 2 type is all that can be supplied by the steam produced from rain and percolating water in the upper part of the conduit, it follows that during explosions of the No. 3 type both rock and steam are rising from a depth in the volcanic conduits. Presumably then, during eruptions of the types No. 3 and No. 4 molten rock is being forced up within the conduit of a volcano and,



St Pierre. Near view of one of the holes. The material of the tanks is quarter-inch boiler iron (see page 425)

From a photograph by Dr E. O. Hovey. Republished from the Bulletin of the American Museum of Natural History

owing to relief of pressure as it rises, the steam dissolved in the molten magma escapes with tremendous violence. There are thus two sources for the steam which furnish the energy displayed in the summit portions of ascending lava columns—one from the rain and percolating water, and the other from a deeper but unknown source. But this attempt to follow the volcanic conduits downward in fancy has brought us to the region of speculation and it is time to stop, at least for the present.

To the four types of volcanic-steam columns described above, a fifth might be added to include volcanic explosions like that of Krakatoa.

Products of the Eruptions.—The material discharged from Mont Pelée and La Soufrière may be divided into two portions: First, steam and gases, and, second, solid rock débris. Up to the present time no observations indicate that molten rock has been extruded; that is, no lava streams have flowed over the surface from the crater of either volcanoes or issued from fissures in their sides.

As to the discharge of vast volumes of steam, there is no difference of opinion to be formed in the various reports already rendered. Observers who have visited the craters from which the recent eruptions came, and have even ventured within them, report only faint traces of gases. The conditions, however, between the time when a crater is quiescent and when violent explosions occur within it are no doubt different, and as yet but little evidence concerning the gases that may have been present during the times of most violent activity has been obtained. The most that can be accepted in this connection is: a plainly perceptible odor of sulphurous acid noticeable in the air even at a distance of some 8 miles at sea, when the volcanoes were in a comparatively mild state of activity, and while walking over the débris they showered on their respective islands. A much fainter odor of sulphureted hydrogen is reported to have been present, as for example, among the ruins of St Pierre, but whether due to gas emitted from the volcano or arising from organic matter buried beneath the still hot débris is not clear. The presence of carbon dioxide, although asserted or surmised to have been discharged during the greater eruptions, has not been proven. The consideration of all the available evidence points strongly to the conclusion that steam was the chief vaporous or gaseous substance emitted, but mingled with it were minor quantities of sulphurous and no doubt other gases.

In the above connection it should be noted that flames above the summit of both Mont Pelée and La Soufrière have been reported by several trustworthy witnesses. If the appearances referred to were in reality flame, and not glowing dust or the reflection of the light from incandescent rocks on vapor, it is evident that inflammable gases were present. No spectroscopic observations seem to have been made, however, and until this is done the evidence as to the presence of inflammable gases in notable quantity must seemingly be received with caution.

The reports that Mont Pelée and La Soufrière discharged mud are probably correct so far as would appear from a distance, yet the true meaning would seem to be that such eruptions were of the nature of the explosions in the pseudo-crater or in the true craters during intervals between the eruptions from a deep source. Hot dust and lapilli accumulating in a crater during quiescent stages would furnish most favorable conditions for the producing of superficial explosions where rain occurred or springs entered a crater from its sides, as has been observed, and would produce eruptions similar to those of the pseudo-crater, and mud flows might result. It is evidently not to be inferred that either of the volcanoes in question has erupted mud from a deeply seated source.

The solid matter discharged from Mont Pelée and La Soufrière is almost entirely in the condition of angular fragments varying in size from those weighing in the neighborhood of one thousand tons to the finest of dust particles. The fragmental material is of two classes: First, fragments of the rocks torn from the walls of the conduits through which the upward rush of débris-charged steam occurred; and, second, fragments of hardened lava which had been forced upward into the conduits in a plastic condition and shattered and blown out by the escaping steam. In addition to the angular fragments of fresh lava, minor quantities of more or less spherical masses of similar material, which were projected into the air while yet moderately plastic, have also been observed. While the term *volcanic bomb* has been applied to much of the ejected material, it is evident that only the somewhat spherical masses referred to deserve to be so called, and even in such instances there is doubt as to the propriety of using the term. Typical volcanic bombs have a round or oval form, with extended and spirally twisted projections at the ends of the longer axis, the spherical or more commonly oval form and the spirally twisted extremities being due to the rotation of the mass during its aërial flight and while yet plastic. No

Boys Carrying Water to Refugee Camp, Georgetown, St Vincent, May 27, 1902

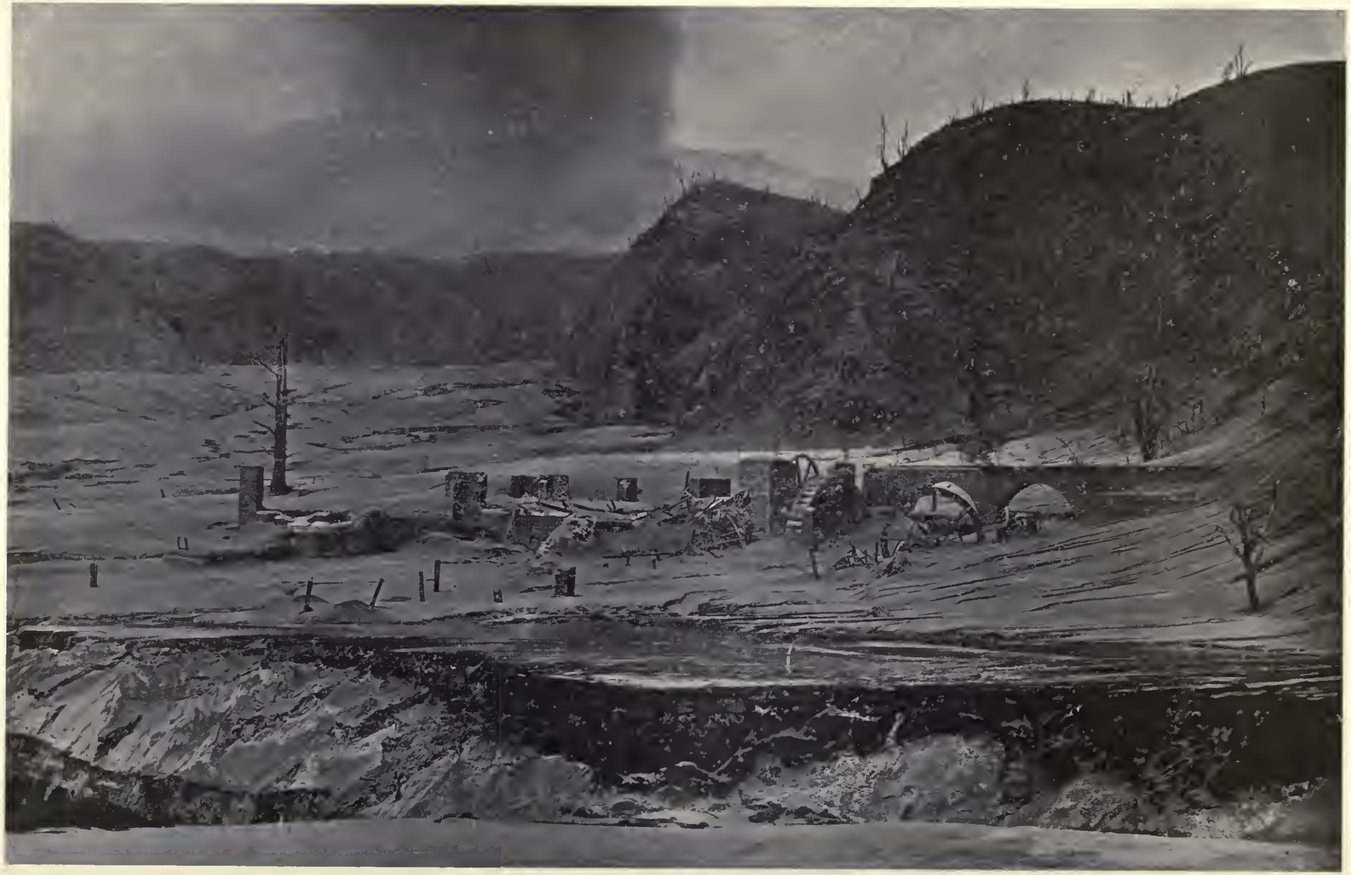
bombs answering this description have as yet been reported as occurring on Martinique or St Vincent. The nearest approach to a characteristic bomb are certain rudely spherical masses of lava with cracked surfaces and without projections or indications of a spiral twist. Evidently these poorly shaped bombs are composed of fresh lava which was sufficiently hot to make it somewhat plastic at the time it was blown into the air, but was too rigid to acquire the typical shape frequently to be seen in large numbers of bombs about certain basaltic craters.

The absence of characteristic bombs on Martinique and St Vincent is in keeping with the composition of the lava thrown out. The fresh lava is an andesite having in a general way the composition of a refractory brick, and unless very highly heated would not be plastic. The dark color of the columns of steam rolling up from the craters when in violent eruption and the vast quantities of fragmental material showered on the adjacent land and sea is evidence that as molten rock was forced up the volcanic conduits it became cooled and stiffened before reaching the summits of the volcanoes, and was shattered by steam explosions and the fragments blown into the air. Not only are true volcanic bombs absent, but clots and splashes of plastic or fluid rocks, such as are common about many volcanoes that have erupted easily fusible material, are also lacking.

The fragments ejected were in many instances blown to a height of many thousands of feet, the finer lapilli and dust being carried perhaps five or six miles high, and on falling were distributed in part through the influence of the winds, in a general way in reference to size and weight. The larger and heavier masses fell near the craters from which they were projected, while much of the finer and lighter material was carried great distances. Variations in the method of distribution were caused by the direction of the hurricane-like blasts which swept down from both Mont Pelée and La Soufrière during their mightier eruptions, by the direction of the trade winds and upper air currents, and by tornado-like swirls in the greatly disturbed atmosphere. The vastness of the area on which the ejected material fell is indicated by the fall of dust on Barbados, Trinidad, and on ships 275 miles southeast of St Vincent.

Observations reported by E. O. Hovey show that, contrary to earlier accounts, written in part by myself, coarse material fell in St Pierre. The riddling of boiler plates one-fourth inch thick, in the northern portion of the stricken city, by stone shot against them from Mont Pelée, is evidence that the hurricanes of steam charged with hot dust, which swept down from that volcano on May 8 or May 20, and perhaps during later eruptions, were accompanied by a bombardment of stones, no doubt hot, which were as deadly as solid shot fired from a cannon.

Causes of Death.—Respecting the general cause of death in St Pierre, the reports of various observers differ more widely than in connection with any



Ruins of the Wallibu Sugar Factory, St Vincent

Photograph by J. C. Wilson. Republished from the Bulletin of the American Museum of Natural History other occurrence connected with the eruption of Mont Pelée, unless it be in reference to the secondary craters referred to above. Obviously many deaths occurred in St Pierre from the bombardment of missiles that swept through the city, as just mentioned, from the falling of walls and other objects, from the fire that followed the volcanic blast, from nervous shock, etc.; but opinions differ as to the principal cause of the loss of life. The opinions referred to fall in two groups: *a*, those favoring the idea that gases were the deadly agency, and, *b*, those which refer the loss of life to the effects of steam charged with hot dust.

a. Certain observers are strongly inclined to the opinion that Mont Pelée, or more accurately, the "Rivière Blanche subcrater," discharged gases which asphyxiated the inhabitants of St Pierre. As to the nature of the supposed gases, at least two suggestions have been made—one that it was mainly sulphureted hydrogen, and the other, carbon dioxide or some similar gas. Coupled with the first of these suggestions is the further hypothesis that gas explosions took place within the city and added to the deadly effect of the asphyxiating gases. The hypothesis that gases were the direct cause of the greater part of the loss of life, as claimed at St Pierre, has not, so far as I am aware, been extended to St Vincent, but the dead and the injured on the two islands met their fate in precisely similar ways. The evidence bearing on the question under consideration has been judiciously discussed by George Kennan, and the testimony of the sole survivor of the disaster of May 8 placed on record. Had noxious gases, and especially such heavy ones as carbon dioxide and sulphureted hydrogen, been swept over the city in sufficient quantities to kill nearly all the inhabitants, it is evident that the occupant of a cell below the level of the adjacent street would have been in a most dangerous position. The testimony of the prisoner referred to, as summarized by Kennan, after a critical cross-examination, is that he "heard no explosions or detonations; saw no flame; smelled no sulphurous gas; and had no feeling of suffocation. He was simply burned by hot air and hot ashes which came into his cell through the door grating."

It is impracticable to review in this essay all the evidence which it is claimed sustains the hypothesis of asphyxiation by gases. This side of the discussion, however, has been well presented by R. T. Hill in the NATIONAL GEOGRAPHIC MAGAZINE, in the *Century Magazine* and in *Collier's Weekly*, and by Angelo Heilprin in *McClure's Magazine* (see list at end of this essay).

b. The efficiency of steam charged with hot dust, or of either of these agencies alone, to cause scalds, burns, and even instantaneous death, is not open to doubt. The question is, Was the steam and hot dust swept over the portions of Martinique and St Vincent at the time so many thousand people were killed the chief agency in their destruction? Cumulative evidence has been added to the various classes of facts presented by me in the July number of this Magazine,* which sustains conclusions then reached. I refer to the narrative of George Kennan published in *The Outlook* for August 16; the preliminary report made by Tempest Anderson and J. S. Flett to the Royal Society of London, and the preliminary report made by E. O. Hovey to the American

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*It was impracticable for me to read the proof of the article referred to, and in the titles of some of the illustrations, especially, there are serious errors. In the title of the plate opposite page 278, "Georgetown" should be substituted for "Kingstown;" the title of the plate opposite page 282, should be "Valley of Wallibu River deeply filled with hot débris;" on page 284, the title of the illustration should read "Summit of Morne d'Orange, St Pierre." The map on page 282 fails to show the area at the north end of St Vincent, as indicated on the original, which was not devastated, and is much generalized in other ways.—I. C. R

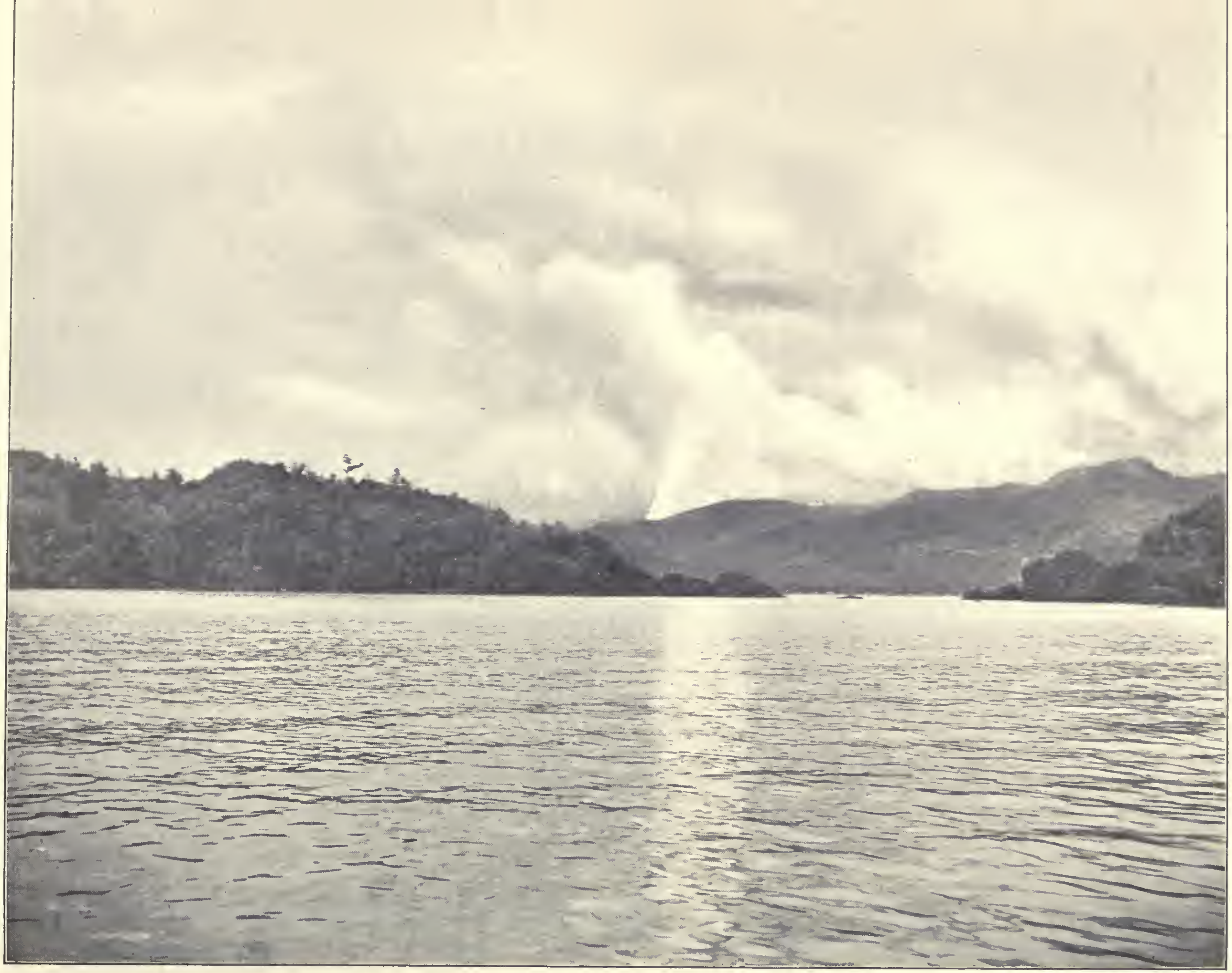
Museum of Natural History. Although frankly confessing that I am not an unbiased judge of the printed testimony, yet it seems fair to claim that the evidence presented is conclusive as to the important part taken by steam and hot dust in the sudden destruction of the people of St Vincent on May 7 and of the inhabitants of St Pierre on May 8.

Downward Volcanic Blasts. — Intimately associated with the destruction of St Pierre is the direction taken by the blast of dust-charged steam, with its volleys of stones, which swept over the city. The hypothesis that St Pierre was destroyed by an eruption from the "Rivière Blanche subcrater" being rejected, and the further suggestion, based on the earlier reports in reference to the opening of a fissure in the side of the mountain, not finding support in later evidence, the way is cleared for a better understanding of the true cause of the direction taken by the down-blast that came, as now seems definitely proven, from the Étang Sec, which is essentially a summit crater.

To understand the nature of the volcanic blast which destroyed St Pierre, one needs to visit the region swept by a similar eruption on St Vincent. The volcanoes on these two islands have not only exhibited a direct relationship in the times of their eruptions, but the surface phenomena exhibited by one is the counterpart of what took place in the case of the other. Happily on St Vincent, however, there was no densely populated city within the radius of greatest destruction.

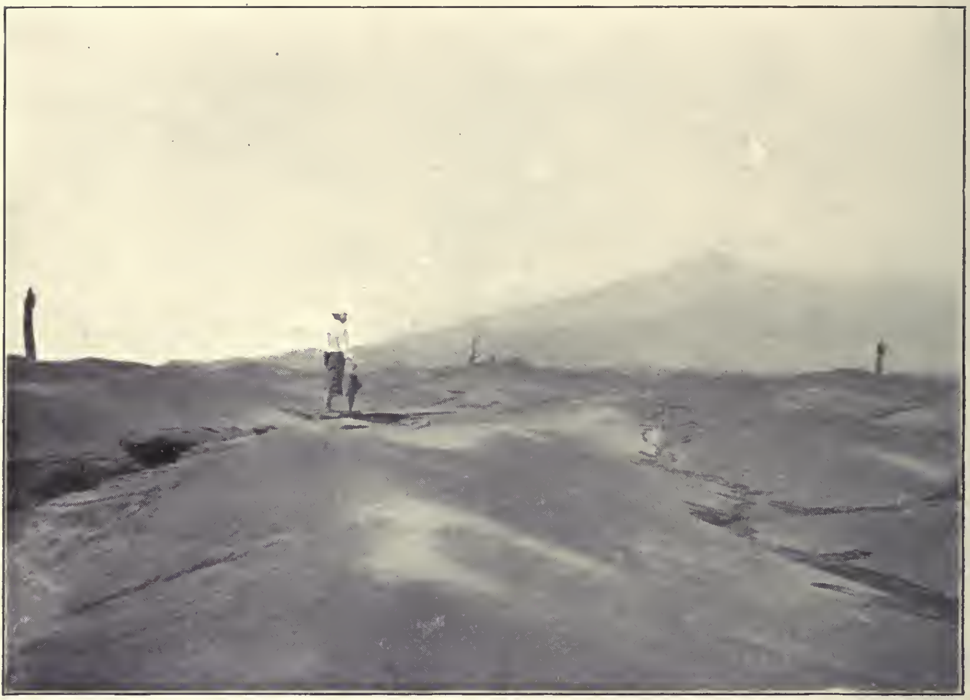
On St Vincent the region throughout which the previously luxuriant vegetation, plantations, etc., were swept away or buried beneath hot dust and stones encircles the mountain. The direction in which trees were swept down, and on the periphery of the devastated area the erosion of the bark of trees still standing on the side facing the volcano, as well as much other evidence, show in a most conclusive manner that a blast charged with dust and stones swept down the slopes of La Soufrière in all directions. The influence of hills at a distance of some four or five miles from the volcano in shielding the vegetation on their slopes facing away from it shows that the topography of the land controlled, in a measure, the direction taken by the volcanic winds. The presence of a partially encircling ridge or *summa*, on the northeast side of the volcano, seemingly accounts for the escape from destruction of a narrow fringe about the northeast border of the island. The outward direction that the blast took from the mountain, its decreasing intensity with increase in the distance it traveled, and the absence of even hypothetical subcraters, all bear witness that the heavily dust and stone charged steam from the old crater near the summit swept downward and outward with hurricane force, in a similar way to the more localized blast from Mont Pelée which destroyed St Pierre.

The one conspicuous feature of Mont Pelée which differs from anything on La Soufrière is the presence in the southwest portion of its active crater of a deep notch—the *Fente* or *Terre Fendue*—which, as stated by Heilprin, has been a conspicuous feature of the mountain since the eruption of 1851, and may have existed previous to that event. This cleft is in plain view from St Pierre, and during my visit to the dead city one could look into it and plainly see the ruddy cone of eruption with its ascending steam column that was being built within the crater. The area rendered desolate by the hot blast from Mont Pelée on May 8, and again swept over by a similar blast on May 20, is fan-shaped, the apex of the triangle being essentially at the summit of the mountain. The coincidence between the position and direction of the Fente and the apex of the expanding volcanic blasts may well be considered signifi-



Near Chateau Bellair, St Vincent, May 25, 1902

Steam rising after a shower, from hot débris in the valley of Wallibu River



Richmond Estate, St Vincent, May 25, 1902

Dunes of wind-drifted volcanic lapilli and dust from La Soufrière on a previously cultivated area. The tree trunks are the remains of palms. The rill channels show the beginning of the erosion of the freshly added layer, which is from three to ten or more feet thick (see page 432)

cant. From the various accounts of the eruptions of Mont Pelée available, it now seems evident that the blasts which destroyed so much of the vegetation of Martinique and wrought havoc in St Pierre came from the crater with a deeply notched rim, and that the direction taken by the blasts, at least on May 8 and May 20, was determined by that rift in the crater's rim.

As stated by T. A. Jaggar, the downward blasts from volcanoes do not require a horizontal nozzle to project them. "They are simply the result of the down-blast after the heavy gravel has begun to fall, acting against the upblast from the throat of the volcano, and both together deflected and thrown into terrific whirls or tornadoes." This explanation, although briefly stated, may seemingly be taken as the leading cause of the downward sweep of the steam charged with rock fragments on both Mont Pelée and La Soufrière. It does not seem clear, however, that the down-blasts occur only after a towering column of débris-charged steam has reached a great height and the fall of the heavier material within it has begun. Then, again, it may be asked why it is that every strong eruption is not followed by a down-blast?

Variations in the character of volcanic eruptions of the type under consideration occur on account of variations in the energy of the explosions and the degree to which the ascending steam is débris-charged. If the energy is great and the upward propelling force essentially constant, it may well be inferred that the column, as explained by Jaggar, will attain a great height before the resistance it offers to the ascent of fresh material causes an expansion at the base. If, however, the steam driven out at any stage in an eruption is excessively loaded with débris, an expansion and overflow at the rim of a crater might occur, no matter whether the fall of previously discharged material from aloft had begun or not. The essential feature in a down-blast from a crater seems to be that heavily débris-charged steam behaves in many ways like a fluid and will flow down steep gradients and acquire great velocity when the slope and other features of the surface over which it progresses are favorable. The gradients on the slopes of Mont Pelée and La Soufrière, within the zone of destruction in each case, are about 1,000 feet to a mile, and, as seems evident, the finally accepted explanation as to the controlling condition which gave direction to the blasts which swept them will include the principle just stated. In this connection it is instructive to note certain observations made by Messrs Anderson and Flett, commissioners sent by the Royal Society of London to study the recent eruptions. On the evening of July 9 these gentlemen were on a vessel near Carbet and witnessed an eruption of Mont Pelée.

"As the darkness deepened, a dull-red reflection was seen in the trade-wind cloud which covered the mountain summit. This became brighter and brighter and soon we saw red-hot stones projected from the crater, bowling down the mountain slopes and giving off glowing sparks. Suddenly the cloud was brightly illuminated, and the sailors cried, 'The mountain bursts!' In an incredibly short space of time a red-hot avalanche swept down to the sea. We could not see the summit owing to the intervening veil of cloud; but the fissure and the lower parts of the mountain were clear, and the glowing cataract poured over them right down to the shore of the bay. It was dull red, with a billowy surface, reminding one of a snow avalanche. In it there were large stones, which stood out as streaks of bright red, tumbling down and emitting showers of sparks. In a few minutes it was over. A low, angry growl had burst from the mountain when this avalanche was launched from the crater." The time occupied by the avalanche to reach the sea was "possibly a couple of minutes. It could not have been much more." . . .

"There is no doubt that the eruption we witnessed was a counterpart of that which destroyed St Pierre. . . . The most peculiar feature of these eruptions is the avalanche of incandescent sand and the great black cloud which accompanies it. The preliminary stages of the eruption, which may occupy a few days or only a few hours, consist of outbursts of steam, fine dust, and stones, and the discharge of the crater lakes or torrents of water or of mud. In them there is nothing unusual, but as soon as the throat of the crater is reached, a mass of incandescent lava rises and rolls over the lip of the crater in the form of an avalanche of red-hot dust. It is a lava blown to pieces by the expansion of the gases it contains. It rushes down the slopes of the hill, carrying with it a terrific blast, which mows down everything in its path. The mixture of dust and gases behaves in many ways like a fluid. The exact chemical composition of these gases remains unsettled. They apparently consist principally of steam and sulphurous acid." . . .

The account just quoted of a typical down-blast from a volcano, seen under favorable conditions by trained observers, is perhaps the best evidence on record from which to judge of the nature of certain phases of several of the recent eruptions. In the instance cited, there does not seem to have been a lofty column of dust-charged steam standing above the summit of the mountain, which deflected the upward blast from the vertical conduit of the volcano, but, owing to the density of the mixture of steam and dust driven out, it overflowed the lip of the crater and rolled down the mountain side. That is, one condition, as previously stated, which may bring about a marked variation in the nature of an eruption, and in fact furnish the chief control of the secondary phenomena, is the density with which the steam extruded is charged with solid matter. This condition may obtain control even when the explosive violence is not enough to drive the dust-laden steam to a great height. The degree of comminution would no doubt be another factor influencing the result. The finer the solid material was comminuted, the more fluid-like would be the mixture.

In an eruption like that described above the topography may exert a decided influence. During eruptions of great but of not the maximum intensity the deep notch in the southwest portion of the rim of the active crater of Mont Pelée would give direction to the escaping dust-charged steam and determine the course the expanding avalanche would take. In the absence of such a notch, as in the case of La Soufrière, the overflow would be radial. A more intense eruption from Mont Pelée might also be radial, the notch in its rim failing to influence so completely the direction taken by the greater discharge. This is what seems to have occurred during the later eruptions of the volcano, when Morne Rouge and other villages were destroyed.

Mud Flows.—The valleys on the lower slopes of both Mont Pelée and La Soufrière have in numerous instances been filled to a depth of 40 to 60 or more feet with hot dust and stones. The streams have thus been displaced, and are striving to regain their right of way, but as yet, owing largely to the washing down of dust, lapilli, etc., from bordering slopes, are making but slow progress with their work. In many instances, in fact, the high-grade rills are bringing to the main drainage channels more débris than the master streams can remove, and the process of valley-filling continues. Water finding its way into these beds of hot débris, as already mentioned, causes steam explosions, sometimes of such energy as to resemble a primary eruption from one of the main or true craters. These eruptions at times hurl large quantities of débris into the stream channels which have been partially cleared, thus producing dams and causing small lakes to form. These water bodies rise until they overflow the accumulation of loose material restraining them, when they are rapidly drained, and floods of water heavily charged with débris occur below where the temporary dams were formed. The mud flows originating in these and other similar ways have been frequent on both Martinique and St Vincent, and have in several instances been referred to as lava flows.

Erosion.—Much that is highly instructive centers about the manner in which the surface waters are removing the freshly added material from the surfaces of Martinique and St Vincent. Instead of being a protection to the surface on which it rests, the fresh débris is in many instances of assistance in its more rapid erosion. On steep slopes and even when the surface is nearly level, the rills formed during the numerous tropical showers quickly cut through the loose surface material and, aided by the angular particles in suspension, corrode the soil or rocks beneath. The rains, as it seems, are heavier than usual, owing to two causes: First, the great amount of water contributed to the atmosphere as steam, and, second, the vast amount of dust blown into the air, each particle of which serves as a center for condensation. The process of fashioning the topography throughout the extensive areas from which all vegetation has been removed is greatly accelerated. This more rapid erosion will, no doubt, continue until the surface is again plant-clothed.

The volcanic eruptions have claimed so much immediate consideration from the several geologists and geographers who have visited the stricken islands that the indirect geographical changes resulting from them have not received the attention they deserve. Not only the pulsating streams of steaming water and their occasional great discharges of hot mud demand detailed study, but the way in which the undermining of banks of loose débris leads to landslides, the development of consequent and subsequent streams, the manner in which streams develop and rapidly pass from youth to old age, etc., deserve to be carefully recorded. The streams are not only eroding but depositing. Deltas are being formed and additions made to the land. The final resting places of the fresh débris which fell on the islands will be in the adjacent sea, where great quantities of fragmental volcanic material is being spread out to form stratified tuffs.

Waves in the Sea.—Reports have appeared in the newspapers, from time to time since early in May, of so-called tidal waves. As is well known, the waves referred to have no connection with the tides, but are similar to those occasionally accompanying earthquakes. So far as can be judged, however, the unusual waves that have recently broken on the shores of Martinique and St Vincent have not been due to movements in the earth's crust, such as commonly produce earthquakes, although some of them may have been of that nature. The waves referred to have been caused, in most instances, by the disturbances produced in the water of the sea by the blasts of dust-laden steam that have swept down from the craters of Mont Pelée and La Soufrière. Similar waves have also been generated by the entrance into the sea of stupendous mud flows, or, perhaps more properly, avalanches of rock débris and water, like the one which destroyed the Guerin sugar factory on May 5. Again, landslides have occurred in the loose deposits on the Caribbean shores of both Martinique and St Vincent, and similar slides, as indicated by the breaking of telegraph cables, have probably taken place on the steep submerged slopes of the mountains whose summits form the islands mentioned. In these several ways, waves in the sea appear to have been generated, but in all instances they have been low and but little damage from them has resulted. The earthquake shocks that accompanied the recent eruptions have been comparatively light, and, so far as can be judged, not of such a nature as to cause large waves in the adjacent sea. The earthquake shocks, however, may and probably did bring about the descent of some of the landslides on the margin of the sea and on the steep submerged slopes, and in this way are indirectly accountable for some of the sea waves.

Landslides.—The landslides just referred to occurred principally on the west side of St Vincent, to the north of Chateaubelair, where strips of nearly flat alluvial land, adjacent to the sea, have disappeared, leaving fresh bluffs of loose débris some thirty or forty feet high. It has been suggested that this disappearance of land, and in one instance of the site of a village, was due to movement along a fault—that is, the subsidence of the rocks on one side of a deep fracture in the earth's crust—but the evidence does not seem to sustain this hypothesis. The lands that have disappeared, as shown by the escarpments remaining, were composed of unconsolidated débris, deposited for the most part directly by streams as deltas. This loose material, resting on the steeply inclined rocks beneath, was in a position to be easily dislodged by earthquake shocks, by the rush of mud avalanches down the valley, at the mouths of which the deposits had been made, and by the return waves when the sea was disturbed by the volcanic blasts or by mud avalanches. The changes made by subsidence of the land are not great, and, as several observers have stated, may reasonably be accounted for in the manner just referred to.

Electrical Displays.—The graphic accounts that have been published of the recent eruption give a better idea of the magnificence of the electrical phenomena accompanying volcanic explosions than was previously attainable. These observations show that an interesting and difficult problem here awaits solution. The most striking phase of what is assumed to have been an electrical display during a primary eruption of Mont Pelée on the evening of May 26 is thus described by George Kennan:

"The feature of the eruption that made the deepest impression upon me was the stellar lightning. The uprush of black smoke, the glow over the crater, and the shower of incandescent stones and cinders were all phenomena that had been observed and described before; but the short, thin streaks of lightning, followed by star-like explosions in the volcanic mantle—not only above the crater, but miles away from it—were entirely new. The distinctive characteristics of this lightning were the shortness of the streak, the comparatively great size and brilliancy of the spark, or light-burst, at the end of the streak, and the single booming report that followed. Sometimes three or four great sparks, connected by fiery streaks, would flash together in this way; and at other times the stars would burst so far back in the cloud that the streaks were invisible and there was only a circular irradiation of the vapor. If there was any storm lightning, of the ordinary kind, in the earlier stages of the eruption, it was so much less noticeable than the stellar lightning that it escaped my observation; and I am quite sure that there was no rolling, reverberating thunder at all until near the close of the display, when reddish lightning-bolts began to dart down on the volcano from the developing storm-cloud over the crater. Before that time all, or nearly all, of the electric discharges had ended in stellar light-bursts, and all of the thunder had been made up of separate and distinct reports, like the thunder of a heavy and rapid cannonade."

In reading this account one can scarcely avoid making the tentative suggestion that the streaks of light and brilliant explosions, apparently resembling the trails and occasional bursting caused by meteoric bodies entering the earth's atmosphere, may have been due to intensely heated solid particles on entering the oxygen-charged air.

Other Phenomena.—A final report on the recent and still continuing eruptions of Mont Pelée and La Soufrière must include the evidence in reference to; the sounds generated, the earthquake shocks, the areas on which dust fell and its relation to the direction and force of air currents, gravity waves in the air, influence of dust in the air on sunlight, and, most interesting of all as well as the most novel, the magnetic waves generated, some of which were recorded almost instantaneously at several magnetic stations in the United States and Canada.

The Study of the Earth's Interior.—Perhaps the chief lesson taught by the recent volcanic eruptions in the Antilles is the meagerness of our knowledge concerning the interior of the earth. In this more pointedly, perhaps, than in related fields is the saying true that "the known is but a small fraction of the unknown." In the study of the earth's interior, the search for the ultimate causes of volcanic eruptions, etc., a visit to an active volcano is most instructive and suggestive, but such investigations should not end with the cessation of the outbreaks.

The manifestations which reach the earth's surface and on which our judgment as to the condition of its interior must be chiefly based are movements in the rocks, earthquakes, escape of heat, magnetic changes, etc. While several of the phenomena referred to become especially prominent during volcanic eruptions, they are not confined to such occurrences or to the vicinity of volcanic vents, but may be studied at all times and at any locality. Among the records which it is desirable to obtain and from which some judgment in reference to the condition of the earth's interior may be had are the occurrence of earthquakes, their character, direction of motion, location, both geographical and vertical, of their centers and all else concerning them, and changes in the magnetic condition of the earth. Observations in these directions are highly desirable in the vicinity of volcanoes in order that they may serve as danger signals, but may yield valuable returns when carried on at a distance from all centers of volcanic disturbance.

In this connection I wish to suggest that the National Geographic Society can make a substantial addition to our knowledge of the earth by maintaining a magnetic and seismographic observatory. Let a start be made by placing in our Hubbard Memorial Building the best instruments of the nature just referred to that can be had, and extend assistance to individuals, colleges, etc., at as many other localities as practicable, in establishing similar observatories.

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THE COPYRIGHT OF A MAP OR CHART

By William Alexander Miller,

Author of "Copyright Protection for Photographs"

WHEN our forefathers were assembled in the second session of the First Congress on the last day of May, 1790, and decided to pass a copyright law, the first article that they mentioned to be protected was a "map." Then in that act followed the words "chart, book, or books."

You think how good a life you will lead, and you map out great purposes.—*Ike Marvel, Dream Life.*

By giving maps the preference, first mention in the law, now seems but to emphasize the fact of the greatest need of the country at that time in such productions. There was a dearth of maps, and prior to the passage of the statute mentioned positively no encouragement to draftsmen and cartographers. The science of chartology was almost unknown and but little practiced in America previous to the advent of the copyright law. What meager accomplishments there were in those lines were generally performed by foreigners. Our country was at sea, without a chart. There had been much plotting against the British, but scarcely none in the making of maps.

Undoubtedly, Miletus was the birthplace of cartography. —*Von Ranke.*

Every ship that comes to America got its chart from Columbus.—*Emerson.*

The law of 1790 was the first of our copyright acts, and secured protection to authors and proprietors for their productions for a period of fourteen years, with an extension for fourteen more. Thus the longest possible term of a copyright was twenty-eight years (a term copied from the provisions of the old English law). Our law-makers have since very wisely extended the life of a copyright, so that now the original is granted for a period of twenty-eight years and with provisions for a renewal for fourteen years additional.

Language has been called a map of the science and manners of the people who speak it.—*Max Müller.*

> It is among the Egyptians that we find the earliest recorded examples of cartographic representation. Apollonius of Rhodes (b. 230 B. C.) reports in his Argonautica that the Egyptians of Colchis, a colony dating from the time of Rameses II, had preserved as heirlooms certain wooden tablets on which land and sea, roads and highways, were accurately indicated.—*Encyclopædia Britannica.*

BENEFICENT EFFECT OF THE LAW

The results expected to be attained by the framers of our law for the encouragement of map-makers have been far beyond any of their reasonable anticipations, until at the present time the United States of America is leading the world in the productions of this wonderful art, one so useful to mankind. The quality of our product is of the very finest.

Thus in his cheek the map of days outworn. — *Shakespeare.*

Not such maps as you wash houses with, but maps of countries. — *Middleton, Spanish Gypsy.*

The government itself, by reason of its great consumption of maps, has been a leading factor in raising the standard and in educating and encouraging the map artist—or should we say the map scientist? Geneva, Switzerland, said to have been for so many years the greatest map-producing center of the world, has been relieved of the laurels she so gracefully wore, and our own Washington carries the honor as one of the pearls in her precious diadem. A dozen different bureaus of our government are engaged in map-work of some sort, not alone of this country, but of all portions of the globe, its seas and skies. It has enticed to our shores the best workmen of Europe.

Peering in maps for ports and piers and roads. — *Merchant of Venice.*

Government maps are public property, so far as the copyright provisions are concerned, and are not copyrightable. This is one of the reasons why private establishments are enabled to issue more and better maps of many kinds at a low price than can be turned out anywhere else on the globe. It is getting so now that when one wishes to make a journey afoot or by train, carriage, wheel, or automobile a map can be consulted for information as to roads, time, distances, grades, bridges, paths, hostleries, repairs, and fuel, to make no mention of the weather and stars and tides. The practical benefits are multifarious.

> When Hecatæus (500 B. C.) warned his countrymen against engaging in a conflict with Darius he enforced his arguments by pointing out the vast extent of the Persian Empire upon a map of the "entire circuit of the world," which had been engraved upon a brazen tablet.—*Mill's International Geography.*

DIRECTIONS FOR OBTAINING COPYRIGHT

It is the design of the writer in this article to give a few simple, elementary directions for the guidance of the applicant for copyright protection. When a map or chart has been produced and the author or legal owner of it desires to obtain the benefit of the copyright privileges, the first step should be to write to the Register of Copyrights, Washington, D. C., for a blank application. These blanks are so arranged that in a few words the applicant can insert all necessary information. The use of the blank will insure the quickest possible favorable action, and any other form of application is liable to omit some vital requirement of the law, causing delay and perhaps vexation. The prime requisites are: Name and address of the applicant; amount of money enclosed and its nature; nature of the article to be copyrighted; title of the work; name of the claimant of the copyright and residence; country in which the article is to be printed or produced; name of the author and of the country of which he is a citizen or subject; form of claim, as to whether author, designer, or proprietor; name and address to whom reply is to be mailed; a copy of the printed title.

After the blank has been received and filled out, there will be noticed that there is a space on the third page for attaching the title of the map. For this purpose the corner of the map which contains the title and the usual copyright notice as it will appear when issued to the public should be cut off and attached to the blank by pasting. This should all be attended to before the day of publication. If possible it is well to send the application, the fee, and the two complete copies required to be deposited, all in one package, to the Register of Copyrights. The results will be quicker and surer.

As to the matter of fees: For each title the fee is 50 cents, provided the author is a citizen of the United States, but if he be a citizen of a foreign country with which this country has copyright relations the fee is $1. If a certificate is desired (which shows how the entry will appear on the records) an additional fee of 50 cents will be necessary. Maps published in two sizes, that is where the scales of the two differ, require two separate entries and fees for copyright. A postal money order is the best form for remitting fees, and it should be made payable to the Register of Copyrights.

I am near to the place where they should meet, if Pisanio have mapped it truly.—*Cymbeline.*

If the article to be copyrighted is a map, it should not be alluded to by any other name. The statement should be plainly made that it is a MAP. It should not be designated a chart, plat, plot, or atlas; an atlas is a book of maps. The applicant must bear in mind the fact that the law contemplates a map as being a delineation of some portion of the earth's surface. Not everything popularly so called is a chart in the meaning of the law.

We map the starry sky.—*M. Arnold.*

If one wishes to protect a chart much care should be exercised, owing to the different meanings given to that term by the public, the dictionaries, and the law. The application should read: "A MAP OR CHART." The law regards a "chart" as a special kind of map, as a delineation of some portion of the heavens or of the waters of the earth, more plainly as a map of stars or a map of waters. Neither is it a plan or drawing of other objects or a card or sheet showing tabulated information. The public is prone to characterize a variety of things as charts, and when they get before the copyright officials meet with disappointment in many instances. As early as 1828 a decision was handed down stating that a copyright cannot subsist in a chart as a general subject (Blunt *vs.* Patten, Fed. Cas. 1580; 2 Paine, 397). If an applicant have a drawing, pattern or chart, as it is commonly called, to be used on a cutting machine and with directions for its use, he cannot obtain a copyright as a "chart," but would have to apply for protection as a "book." In the case of Drury *vs.* Ewing (Fed. Cas. 4095; 1 Bond, 540) the court decided that a chart on a single sheet, containing diagrams representing a system of taking measures for and cutting women's dresses, with instructions for its use, is a "book," within the copyright law. Another has a music staff and scale which he terms a "musical chart." The law knows of no such "chart," and the only possible chance for the applicant might be in apply-ing as a "book." Then there is "A Chart of the Greater United States—An Up-to-Date Historical, Political and Statistical Record, with Maps, Etc." That would be a "book" pure and simple and should be applied for as such. Another phase of the meaning of the word "chart" will be seen in the decision of the court in the case of Taylor *vs.* Gilman (24 Fed., 632), in which it was held that the word "chart" as used in the copyright law does not include sheets of paper exhibiting tabulated or methodically arranged information, but such articles might be protected as books.

The law requires that on or before the day of publication two copies of the completed map or chart shall be deposited with the Librarian of Congress. In the case of a map or chart, unlike that of a book, photograph, chromo, or lithograph, the two copies to be deposited need not be made in the United States. It would seem that the day has now arrived when the provision should be inserted in our law requiring the copyrighted maps and charts to be engraved and printed in this country. There is a provision in the statutes for the granting of copyright on new editions wherein substantial changes shall be made. In such case it is necessary either to make out a new application, as in the first instance, and send it, with the proper fee, to the Register of Copyrights, and on or before the day of publication forward two copies of the article for deposit; or, merely deposit one copy of every such edition without making a new application. It is perhaps better to file a new title, describing the map or chart as being the second or third or some other edition, revised, etc. In 1872, in the case of Farmer *vs.* Calvert Lithographing Company, the court held that new editions of maps are included in the copyright laws (Fed. Cas. 4651; 1 Flip., 228).

> The scientific treatment of geography and map-making has its origin among the Ionic Greeks of Asia Minor. Anaximander, a pupil of Thales (about 560 B. C.), sketched the first map and was the first who sought to determine the compass of the earth (the world disk) and the sea.—*Encyclopædia Britannica.*

HISTORY OF THE DEPOSIT OF COPIES

The matter of the deposit of the copies has had quite a little variety in its history. The original copyright law required that but one copy of the map should be deposited with the Secretary of State within six months after the day of publication. In the first general revision of the copyright laws, which occurred in 1831, it was stipulated that one copy of the article protected should be deposited within three months after publication with the clerk of the court who recorded the title, and this copy was to be sent by the clerk of the court to the Secretary of State. That was during the days when copyright applications were made to the circuit courts of the United States instead of to the Register of Copyrights, as at the present time.

> There was no other pastime nor exercise among the youth but to draw plattes of Sicile and describe the situation of Libya and Carthage.—*Plutarch.*

On the establishment of the Smithsonian Institution by the act of August 10, 1846, the above provision as to the deposit of copies was changed, requiring the delivery within three months from publication of one copy to the Librarian of the Smithsonian Institution and one copy to the Librarian of Congress. In the Post-Office Department appropriation bill for the fiscal year 1856 (passed March 3, 1855) free transportation through the mails was provided for copyright deposits. In an act providing for keeping and distributing public documents, passed February 5, 1859, it was declared that the copyright deposits and records should be removed from the Department of State to the Department of the Interior. By the act of February 18, 1867, a penalty of $25 was imposed for failure to deposit copies in the Library of Congress.

In the second revision of the copyright laws (act of July 8, 1870) all records and other things relating to copyrights, including the deposits of books, maps, etc., in the Department of the Interior, were transferred to the Library of Congress. The Librarian was required to give an additional bond of $5,000, and his salary was increased to $4,000. By this law two copies of the best edition of any article copyrighted was to be deposited within ten days after publication in the Library of Congress and one copy of any subsequent edition. The provisions of the law now in force regarding the deposit of copies have been already given above.

Of the two copies of each map or chart deposited in the Library of Congress one is retained in the files of the Copyright Office and the other is placed in the Division of Maps and Charts. The map room of the Library is one of the most interesting portions of that great building and is liberally patronized by cartographers, scientists, and students generally.

In another roome are represented at large mapps and plotts of most countries in the world.—*Evelyn, 1645.*

> Marinus of Tyre (about 150 A. D.) was the first who sought to give effect to the demands made by Hipparchus for a trustworthy representation of the countries of the world.—*Encyclopædia Britannica.*

THE COPYRIGHT NOTICE

In obtaining a copyright on a map or chart there are three steps to be taken: (1) Deposit of printed title; (2) Deposit of two complete copies; (3) Insertion of the proper notice of copyright. The first two steps have been discussed, and now we come to the last one of the three. When one critically examines the notices as published, in the great majority of cases they are illegal, inasmuch as they do not follow the form prescribed by the statutes. In the original law a copy of the record was to be published in one or more newspapers of the United States for four weeks. No other notice was required.

By the act of 1802 it was required to be inserted at full length a copy of the record on the title page or page following in case of a book, but if map or chart should cause the following words to be impressed on the face thereof: "Entered according to the act of Congress, the — day of ——, 18—, by A. B., of the State of ——." This in addition to the publication in the newspaper as before. By the act of February 3, 1831, the notice was changed to read: "Entered according to act of Congress in the year —, by A. B., in the clerk's office of the District Court of ——."

When the Librarian of Congress assumed control of the copyright affairs by virtue of the act of July 8, 1870, the notice was changed to: "Entered according to act of Congress, in the year ——, by A. B., in the office of the Librarian of Congress, at Washington." The latter version was reënacted in the revision of the copyright laws in 1873 (December 1), but by the act of June 18, 1874, it was made optional as to whether one used that notice or "Copyright, 18—, by A. B," the latter being the briefest and best, covering all essentials. At the present time the applicant has the choice of the two forms, though the cumbrous old methods are nearly obsolete and the shorter one has come into almost universal use. The trouble in many cases is that either the date or the name of the proprietor of the copyright is omitted.

It will be seen that there are three things necessary in the notice: (1) Statement of copyright; (2) year in which printed title was deposited; (3) name of the proprietor of the copyright. To emphasize the necessity of giving proper attention to the notice it will be well to here cite the decision in the case of King *vs.* Force, in which the court held that "the omission to have the date of depositing the title of the map engraved thereon is fatal to the plaintiff's title to a copyright (King *vs.* Force, 2 Cranch, C. C., 208). That was as early as 1820. Error in the mention of the date in the copyright notice may be attended by serious consequences or it may be practically immaterial. In the case of Callahan *vs.* Myers the court said: "The title having been deposited in 1867 it is immaterial as to third persons that the notice printed in the work states that the copyright was entered in 1866." Here the error would result simply in shortening the period of copyright protection one year, which in most cases would not be considered a matter of consequence. But if the error was the other way, that is, if the year mentioned in the copyright notice was subsequent to the year of copyright entry, the consequences would be most serious, for in a case where the title page of a book was deposited in 1846 and the notice of the entry as printed in the copies of the book stated the entry to have been made in 1847, the court held that the error, whether arising from mistake or not, was fatal (Baker *vs.* Taylor, 2 Blatch., 82).

> The Romans contributed nothing to the development of the scientific methods of the Greeks, and did not apply astronomy to the purposes of cartography. They valued maps according to their practical utility as implements of political administration; and they accordingly attached most importance to the route-map, from which they could learn the roads and the distances.—*Encyclopædia Britannica.*

OTHER LEGAL DECISIONS

A survey of a shoal made by plaintiff at his own expense, and used as the basis of a map copyrighted by him, does not become a public document by being deposited in the Navy Department for the use of the government, so that a third person may also use it as the basis of a map (Blunt *vs.* Patten, Fed. Cas. 1579; 2 Paine, 393).

Copyright, being an incorporeal personal right, is not liable to be seized by sheriff in execution, etc. Even when one has obtained a copper-plate under an execution he is not thereby entitled to print and publish copyrighted matter therefrom (Stephens *vs.* Cady, 55 U. S., 14 How., 528; 14 L. Ed., 528; Fed. Cas. 13400; Stevens *vs.* Gladding, 58 U. S., 17 How., 447; 15 L. Ed., 155). The profits, however, may be reached by a creditors' bill.

The right of an author or of a proprietor under the copyright law is infringed only when other persons produce a substantial copy of the whole or of a material part of the book or other thing for which he secured a copyright; but any one by his own labor, etc., may make a new map, and where, therefore, the owner of a copyright for maps of certain wards of the "city of New York, surveyed under the direction of insurance companies of said city, which exhibit each lot and building, and the classes as shown by the different coloring and characters set forth in the reference," brought his bill to restrain the publication of similar maps of the city of Philadelphia, the court held that the bill could not be sustained (Perris *vs.* Hexamer, 99 U. S., 674; 25 L. Ed., 308). To maintain an action the complainant must show that his map has been copied.

The statement has been made that occasionally some map-makers intentionally introduce slight errors in order to more effectually catch the unwary infringer. Appearance of such an intentional error has been held evidence of copying. From the identity of the inaccuracies, it is impossible to deny that the one was copied from the other *verbatim et literatim* (Longman *vs.* Winchester, 16 Ves., 269. See also Murray *vs.* Bogue, 1 Drew, 366, and Lawrence *vs.* Dana, 2 Am. L. T. R., N. S., 402). The penalty for the infringement of a copyrighted map is $1 for each copy found in the possession of the infringer, provided that the sum to be recovered in any one action shall not exceed $5,000. The plaintiff can also demand an accounting of the profits and obtain an injunction to prohibit further infringement.

I see, as in a map, the end of all.—*Richard III.*

What ails us, who are sound,
That we should mimic this raw fool, the world,
Which charts us all in its coarse blacks and whites?
—*Tennyson.*

THE ERUPTIONS OF LA SOUFRIÈRE, ST VINCENT, IN MAY, 1902[*]

BY EDMUND OTIS HOVEY

THE surface rocks of the island of St Vincent are wholly of direct volcanic origin, with the exception of some elevated beach conglomerates occurring along the windward (eastern) coast. These conglomerates, too, are composed of boulders and gravel of volcanic origin derived from the island itself. These conglomerates, water-worn sea benches at three altitudes, elevated sea caves, and the evidence of an old shore line northwest of Georgetown are indications of an elevation of the island of about 200 feet during recent geologic time. The southern portion of the island is the oldest, as is evidenced by its stage of erosion, which is much farther advanced than that of the northern part. Broad valleys, with bottoms of comparatively gentle slope, are to be found about Kingstown, Calliaqua, Mariaqua, Mesopotamia, and elsewhere in the south, while the northern half of the island is remarkable for the extremely rugged character of its topography.

Volcanic activity on St Vincent has moved from south to north, as it has on Martinique, St Kitts, and some of the other Caribbean Islands, but it has long centered about the present active crater, La Soufrière. Numerous lava beds alternate with the, apparently, far more extensive beds of tuff agglomerate in the make-up of the island. Tremendous eruptions of the explosive kind, like the present one, though on a far larger scale, have been frequent occurrences in the geologic history of the island. According to Hill,[†] the volcanic Caribbean Islands date from at least as far back as Eocene time, but eruptions have been very rare within historic time, which extends over four centuries. The heaviest recorded eruptions have been those of La Soufrière, which took place in 1718 and in May, 1812. The latter is said to have formed the "New" crater, 500 feet in diameter, on the northeast side of and higher than the much larger "Old" crater. The Old crater was about nine-tenths of a mile long from east to west and about eight-tenths of a mile wide from north to south, according to the British Admiralty chart, and was famous for the beautiful lake within it, the surface of which was 1,930 feet above tide, or about eleven hundred feet below the southern rim of the crater. The depth of this lake in the center was 87½ fathoms, according to the statement of P. F. Huggins, engineer, of Kingstown, who told me that he sounded it in 1896 (see table in appendix). The northwestern portion was deeper, but Mr Huggins's line was too short to reach bottom there. The walls of the crater were precipitous, like those of Mount Misery, on the Island of St Kitts, and others, while the outer slopes of the mountain were comparatively gentle, except as they were deeply cut into by the very steep-sided ravines of erosion.

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[*] The author was sent to Martinique and St Vincent by the trustees of the American Museum of Natural History, New York, as the representative of that institution, to study the phenomena in connection with the eruptions of the present year. I was a passenger with the delegates of the National Geographic Society on the United States cruiser *Dixie* on her memorable voyage for the relief of the impoverished inhabitants of the devastated islands, and I indorse most heartily the praise given by I. C. Russell and R. T. Hill, in their reports to the Society, to Capt. R. M. Berry, U. S. N., commanding the *Dixie*, and to the other officers of the cruiser for their hospitality and their kindness to the scientists.

On St Vincent our work was greatly facilitated by the intelligent activity of F. W. Griffith, government clerk, acting under general instructions from Sir Robert Llewellyn, C. M. G , governor of the colony, and by the assistance rendered by T. MacGregor MacDonald, a planter owning several estates on the leeward (west) side of the island. James E. Richards, a merchant of Kingstown, placed at the disposal of my colleagues (Dr. T. A. Jaggar, Jr., and George Carroll Curtis) and myself his cottage at Petit Bordel, near Chateaubelair on the leeward coast, from which there was an unobstructed view of the volcano. The facts embraced within this article have been embodied, together with the author's observations on Mont Pelée, in a "Preliminary Report," presented to the trustees of the American Museum of Natural History, and published in the "Bulletin" of the Museum, vol. xvi, pp. 333-372, pls. xxxiii-li.

[†] This Magazine, vol. xiii, p. 229, July, 1902.

It is difficult for one who has not visited the Lesser Antilles to realize the precipitous character of the ravines cut into the old tuff beds by the mountain torrents. Slopes of 65° and 75° are common, while those of 85° and verticality are not rare. Under the usually prevailing conditions, every slope is covered with such dense vegetation that its true character is not perceived at once, but the denudation on St Vincent and Martinique resulting from the terrible blasts occurring during the eruptions of this year has revealed in a striking manner the wonderfully rugged topography of the northern parts of the islands.

In April, 1901, earthquakes began to be noticeably more frequent than usual at Kingstown, suggesting to F. W. Griffith, of that place, the idea that trouble might be expected from La Soufrière, as had happened ninety years before, according to the diary of his grandfather, who was living at Kingstown at the time. Mr Griffith's prophecy received little attention, but by December of last year La Soufrière itself was rumbling to such a degree that the people living on the Windsor Forest and other estates on the northwestern and western slopes of the mountain became greatly alarmed, and could with difficulty be persuaded to remain at their homes. During the succeeding weeks the rumblings became less violent, only to return with renewed force in February.

The warnings of an approaching eruption became so unmistakable by the end of April and the beginning of May that nearly every one had left the doomed leeward district north of Chateaubelair by the 6th of the latter month. On the windward side conditions were different, and but little alarm seems to have been felt. The earthquakes were not as severe and it was supposed that, in case of any eruption, the trade winds would carry all ejecta toward the west. A deceptive security! When the great outburst took place, at 2 p. m., May 7, but one person was killed on the leeward side of the island, while on the windward side about thirteen hundred and fifty persons were killed outright during the eruption or died afterward of injuries received then. Thousands of families in the northern half of St Vincent were rendered homeless and destitute by the storm of lapilli (volcanic dust and ashes), which in a few minutes swept every vestige of tropical verdure from about one-third of the island, replacing the beautiful variegated green of the slopes with a uniform dull gray—the token of desolation.

Mr MacDonald,* from his estate at

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* Mr MacDonald's notes were published in full in the Kingstown *Sentry* of May 16, 1902. They have been published also in the *Century Magazine* for August, 1902, vol. lxiv, pp. 638-642. The compiler of the latter account in his preliminary note has confounded the Richmond Vale estate with the Richmond estate. Mr MacDonald, fortunately, does not own the Richmond estate, which lies between Richmond and Wallibu Rivers and was destroyed by the eruption. The Richmond Vale estate belongs to the MacDonald brothers and was not seriously injured by the May eruptions, but the September outbursts destroyed the cultivation and damaged the buildings. The house is half a mile northeast of Chateaubelair.

Richmond Vale, was an eyewitness of the great eruption of May 7, and has contributed most valuably to the knowledge of the history of that outburst through the careful notes which he kept of the events of that memorable day, up to the time, 1.55 p. m., when it seemed extremely dangerous to remain longer at his post of observation. He had an unobstructed view of the upper portion of La Soufrière. Mr MacDonald's account of the eruption of the principal day, however, must be prefaced by an extract from the notes of Mr Mathes, a German from South America, who was visiting at Chateaubelair and witnessed the eruption. Mr Mathes says that the first outburst of steam from the crater took place at 2.40 p. m., May 6, and that steam and "smoke" clouds rose from the summit at intervals until 5.40 p. m., when all was clear ; but at 6.05 o'clock there was another outburst with a very thick cloud of dust. According to Mr MacDonald, such eruptions took place at intervals of an hour and a half to two hours throughout the night. By 10.30 of the morning of the 7th the outburst had become continuous, the column of steam rising to a height seven or eight times the altitude of the mountain, or at least 30,000 feet. The display of lightning about the column was constant and impressive, being vivid in the extreme. At 1 o'clock large stones could be distinguished in the ascending clouds of steam and dust. These seemed to fall to windward. Tremendous roaring mingled with the thunder and lightning to produce terror in the minds of beholders. Just before 2 o'clock there was a marked increase in the already great activity, with great showers of stones to windward, and "a terrific, huge, reddish and purplish curtain" advanced toward Mr MacDonald's house, causing him to consider discretion the better part of valor and to take to a boat which he had in readiness for the emergency. He and his boatmen thought that they would be overwhelmed by the cloud, but they made good their escape, though many stones fell into their boat.

From 2 o'clock onward of that terrible Wednesday the volcano was enveloped in a dense cloud of dust and steam, from which red-hot rocks fell in torrents, and anything like continuous and calm observation of phenomena was out of the question. The present appearance of the mountain slopes corroborates Mr MacDonald's observation that most of the large stones fell to windward. Stones six inches, and perhaps more, in diameter fell in Georgetown, five and one-half miles in an air line from the crater to the southeast. I observed blocks two feet in diameter in the material from this eruption four miles from the crater, while on the actual slopes of the mountain such blocks even four feet across are to be found. On the leeward side the absence of stones, especially near the crater, is remarkable, but we found some as large as one's head in the débris covering Richmond village, four miles southwest of the crater.

The eruptions continued with abating force for some days after the great outburst of May 7, but, after a few days of quiet, the crater broke out again on Sunday evening, May 18, and the eruption was so violent that there was a heavy shower of stones in Kingstown, the capital of the island, which is about twelve miles distant from the crater in a straight line. This eruption was very short-lived.

The first ascent of La Soufrière since the eruption of May 7, 1902, was made on Saturday, May 31, by Messrs Jaggar, Curtis, MacDonald, and myself, with six porters. We went up from the site of Wallibu village, on the leeward (west) side, following the remains of the old trail across Trespé Valley and along the tops of ridges to the elevation of 1,500 feet above tide, where we came upon

Mont Pelée in Eruption, May 28, 1902

From a photograph taken by Mr George Kennan from Acier and republished from The Outlook of August 2, 1902, by permission of the editors

the remains of the "Half-way tree" lifting its denuded and scarred limbs in mute protest against the terrible devastation all about.

Trespé Valley had a heavy deposit of volcanic ash in it comparable to that in the Wallibu Valley, but secondary steam action in the beds had ceased there by the time of our visit, though we observed crevices through which warm vapors were still rising. There was no direct way of measuring the thickness of the new deposit in this valley, but the principal stream bed was cut down through more than ten feet of it without reaching the old level. From a distance the crests of the radial ridges on the mountain looked like well-trodden paths leading to the summit. This appearance was due to the fine mud forming a sticky mass and remaining on the comparatively flat crest until the newly imposed dendritic drainage advancing up both sides of the ridge should meet along the crest.

The steepness of the ravines cut into the ridges, and of the main gorges as well, hinted strongly at recent topographic features, and at first seemed to indicate an immense amount of erosion during and since the May eruptions. This opinion soon was abandoned by the author on account of the patches of undisturbed surface soil and uncharred roots to be seen here and there on nearly every slope, where the coating of fresh ash had been washed away. Bluffs, however, which had been exposed to the full fury of the volcanic sand blast were stripped of surface soil and roots and showed nearly horizontal scarification as a result of the impact of the wind-driven lapilli. In spite of this scouring and of the evidence of local landslides, it was clear that no radical change in this phase of the topography had resulted from the eruptions.

At 1,500 feet above the sea we encountered slopes coated with soft mud, which usually was from six inches to two feet deep, but which sometimes seemed to be much deeper. This feature prevailed up to the rim of the crater and made travel very laborious. Water soaking into the mass of fine dust had formed this soft mud, and it would not have taken a great additional supply of moisture to turn the mixture into a fluid mass which would rush down the mountain and out to sea as a "mud-flow."

We had started from the ruins of the Wallibu sugar works at 7.30 in the morning, and at 9.49 Mr Curtis stood upon the crater rim of La Soufrière, Dr Jaggar, Mr MacDonald and I following some minutes later. Our elevation was determined to be 2,790 feet above the sea by taking the average of the readings of our three aneroid barometers. We found the crater probably unchanged in diameter, as nearly as Mr MacDonald could tell, and therefore to be about nine-tenths of a mile in diameter from east to west and eight-tenths of a mile from north to south, judging from measurements made on the map. The beautiful crater lake had disappeared, of course, but there was a small lake of boiling water in the bottom of the pit, from the southeastern quarter of which steam was ascending in a strong column. This column at intervals was carrying up quantities of black sand with it to moderate heights above the bottom of the crater. We estimated the surface of the boiling lake to be about 1,600 feet below the point on which we were standing and 2,400 feet below the highest point of the rim, which was on the northeastern side. The lake seemed to be shallow, judging from some nearly flat ground in the bottom of the crater northeast of the water. Our estimate would indicate that the surface of the water was 1,200 feet above the sea, or 730 feet lower than the surface of the old lake.

Almost directly opposite the point where we first reached the rim was the wall and saddle, between the "Old" crater and the crater of 1812, apparently unbroken by the eruption. From the lower third of this series of nearly vertical rock faces and agglomerate beds there issued a strong stream of water which cascaded down the precipices and flowed across a rather narrow strip of nearly level ground in the bottom of the crater and emptied into the boiling lake. It seemed as if this stream must be the discharge of the waters now collecting in the crater of 1812, where there was a little lake before the eruption of the present year. Tremendous avalanches of rocks and earth descended the inner precipitous slopes of the crater at intervals during our stay on the rim. They made a great deal of noise, and may have occasioned some of the "groaning" of the volcano reported by the islanders.

The rim of the crater seemed to be formed all the way round of tuff agglomerate some scores of feet in thickness and sloping inward at an angle of about 30°. The elevation of the crest varied from 2,600 feet to 3,623 feet, according to the chart. Below this bed began a series of beds of solid lava alternating with beds of tuff. Through this portion of the mountain the walls of the crater seemed to be nearly, if not quite, vertical. The beds of lava showed fine columnar structure perpendicular to the surfaces of cooling, and a dike, perhaps forty feet wide, cutting all the series from the bottom of the crater up to a lava bed at 3,000 feet altitude on the north side of the vast pit, showed well-developed horizontal columns. The relative positions of beds and columns on the east side of the pit showed that after the great cone had been built up to an elevation of about 2,500 feet an eruption took place which breached the cone and sent a stream of lava out to windward. At the close of that eruption the lava filled up the breach, and subsequent eruptions sent flows of lava and threw beds of ash over it.

The western side of the crater rim showed a gash leading into the Larakai Valley, but the bottom of the gash was more than a thousand feet above the bottom of the crater. Mr MacDonald said that the gash was there before the eruption took place, but that it seemed to him to have increased in size since the outbursts began. The gash is very much smaller than that in the southwest side of Mont Pelée, and it does not seem to have had any determinable effect in concentrating the force of Soufrière's volcanic hurricanes.*

On June 4 Messrs Jaggar, Curtis, and I made an attempt at the ascent from the windward side. We reached the altitude of 3,200 feet, but turned back without getting to the crater itself, on account of the dense trade-wind clouds. Dr Jaggar felt obliged to leave St Vincent on the next day, but Mr Curtis and I remained at Georgetown to study the coast line and the Rabaka Dry River and to try the Soufrière again. On June 9 Mr Curtis and I made our third ascent, alone, except for one guide, and reached the rim of the crater on the southeastern side two or three hundred yards beyond the spot at which we had turned back on the preceding occasion. For fifteen or twenty yards back from the edge of the rim there were crevices in the ground many yards long and up to three inches wide, which formed lenses with the edge itself and indicated the imminence of landslides into the crater. We pushed along the rim northward until, at an altitude of 3,550 feet (aneroid) above the sea, we stood between the large crater and the crater of 1812.

The summit of La Soufrière east of the large crater and south of the small one is formed by a rather small plateau which slopes gently toward the southeast, closely analogous in position to the small plateau on the eastern summit of Mont Pelée which was the site of the Lac des Palmistes. This plateau was covered with a bed of dust, lapilli, bombs, and ejected blocks which was ten to fifteen feet thick in places, and the trenches cut by recent rains made traveling very laborious, except near the edge of the crater. The rim immediately above the most active portion of the great crater (its southeastern quarter) was precipitous and almost overhanging. Steam seemed to issue from it almost up to the very edge of the plateau. The steam smelled of sulphur gases.

In spite of clouds and rain, this visit, through occasional glimpses of the interior, led me to the conclusion that the crater of 1812, which for nearly a century has gone by the name of the "New" crater, took no active part in the eruptions of May of the present year, an inference based on the following considerations: The saddle between the two craters appeared to be intact, confirming the observation made from the other side of the large crater; a knife-edge ridge which ran at a steep incline from the saddle to the bottom of the small crater and formed the pathway for descent into it before the eruption was still there and had on its slopes bare trunks of trees standing; in the bottom of the crater along the base of this ridge we could see talus slopes of dry (?) dust and lapilli which had slid and rolled down its sides; although the roaring of the steam and boiling water nearly half a mile below us in the large crater was obtrusively discernible, no sound whatever came from within the crater of 1812; the rim of the small crater showed less and less dust as one receded from the edge of the great crater.

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* The reports (communicated to me by Mr MacDonald) of persons who have visited the summit of the mountain since the great eruptions of September indicate a further enlargement of this gash, and some "notching" or lessening in height of the saddle between the large crater and the crater of 1812.

Samuel Brown, a ranger or care-taker on the Lot 14 estate on the southeast slopes of La Soufrière, who was our guide, when we reached the small crater, told us that he watched the eruption of May 7 until the great outburst at 2 o'clock, and that no cloud of steam or "smoke" rose from the small crater. Furthermore, at the time of my leaving the island, June 10, no column of steam had risen above that crater since May 7. Brown was at the sugar factory of the estate, three and one-half miles in a straight line east-southeast from the crater, a most favorable spot from which to observe what was going on at the summit of the mountain. He saved his life by running into the rum cellar of the factory and closing the door and the window shutters just before the volcanic blast swept over the building. On inquiry in Georgetown I found persons who had watched the eruption from the town and had noted the fact that no column of steam rose from the small crater.

Although there are many ancient lava beds in the composition of the mountain, no *stream* of melted lava has issued from La Soufrière during the present eruption. The "bread-crust" bombs, however, which occur plentifully on the mountain sides, especially on the windward slopes, show that during the present eruption molten lava has been present in the throat of the volcano, and that many lumps of melted or half-

La Soufrière. Interior of Crater. Eastern Wall Showing the Alteration of Columnar Beds of Lava with Deposits of Tuff Agglomerate

From a photograph taken by Dr E. O. Hovey, May 31, 1902

La Soufrière. Western Part of Great Crater

From a photograph taken by Dr E. O. Hovey, May 31, 1902

melted rock were thrown into the air. Besides the bombs, the volcano ejected blocks of ancient andesitic lava of several kinds and of varying degrees of coarseness of grain, and of all sizes up to masses six or eight feet across, and vast quantities of coarse and fine lapilli and dust. Most, if not all, of the blocks were thrown out at high temperatures, as is shown by their cracked condition, though they were not actually fused. Although a few bombs, some of which were twelve to fifteen inches across, were found on the leeward side as far away from the crater as the site of Richmond village, three and one-half miles distant, by far the largest number of both bombs and blocks, as well as the largest specimens, were found on the windward side, bombs fifteen to eighteen inches in diameter being common in the bed of the Rabaka Dry River. The proportion of old lavas in the ejecta of La Soufrière seems greater than in those of Pelée, and there is greater variety, apparently, in their composition.

The bombs thrown out by La Soufrière are not as perfect in development as those ejected by Mt Pelée, a difference that seems to be due to the greater basicity of the St Vincent lavas. The more basic rocks, having a lower melting point, would be more nearly fused in the throat of the volcano, or would remain fluid for a longer time than the more acid. Bread-crust bombs seem to be confined to relatively acid lavas. They are typically developed in the andesitic ejecta of Vulcano and Mt Pelé. They are absent from the more easily fused basaltic material thrown out by Vesuvius, Etna and the Hawaiian volcanoes.

The area of devastation on St Vincent is very large in proportion to the total area of the island. After plotting that of the May eruptions out carefully on the British Admiralty chart and measuring the area with a planimeter, I find that it was 46 square miles, practically one-third the entire area of the island. From much of this devastated area, however, the ashes were being washed off so rapidly by the rain that vegetation was already asserting itself by June 10, the date of my leaving St Vincent. The tremendous eruption of September 3, however, is reported to have extended considerably the area of present ruin, particularly on the leeward side of the island. The cable dispatches state that the estates of Richmond Vale, Sharp's, Petit Bordel, Cull's (Swat's?) Hill, Trumaka, and Cumberland have lost all their present cultivation and have lost buildings through crushing, while a private letter from William J. Durrant, of Kingstown, informs the author that much volcanic sand fell as far south as Peter's Hope, five miles below Chateaubelair. On the leeward side of the island, therefore, the boundary line of the zone of destruction probably now is about two miles south of Chateaubelair. The area on the windward side is reported not to have been extended by the September eruption.

Extensive landslides have taken place on the western side, removing a strip of coast, in places one hundred yards wide, continuously from the mouth of the Wallibu River to Morne Ronde village, a mile and a half to the north, and at intervals for two miles farther north. These landslides have left precipitous walls along the shore line, and deep water is found where villages stood and prosperous plantations existed before the eruption. We had no sounding line, but our boatmen could not touch bottom with a twelve-foot oar three feet from shore on the site of Morne Ronde village. The sections left by the slides show that the land which has disappeared consisted of delta and coast-plain deposits, material which would easily be dislodged from the more substantial lava, flows and agglomerate beds by the vibrations due to the eruptions. The eastern, or windward, side of the island is not nearly as steep as the leeward, and landslides have not occurred there as features of this eruption. On the contrary, the windward shore line from Black Point, a mile south of Georgetown, northward almost to Chibarabou Point, more than six miles distant, has been pushed out by the vast quantities of fresh lapilli which have been brought down from the slopes of the volcano by the rivers and the heavy rains during and since the eruptions and distributed by the ocean currents. When I was at the locality, on May 27, I noticed that the shore line at the landing jetty of the Rabaka sugar works, a few rods north of the mouth of the Rabaka Dry River, had been extended half way to the outer end of the jetty, a matter of 40 or 50 yards, by the black volcanic sand brought down by the torrents. By June 5 the point had been washed back nearly to the old shore line again and the material distributed along the coast, especially in the little embayments.

A large amount of material was brought down by the Rabaka Dry River an hour in advance of the great outburst of May 7, which seems to have been due to the bodily discharge of a portion, at least, of the old crater lake into the headwaters of that stream. Survivors who attempted to cross the Rabaka Dry River toward noon of that day report that they were prevented by a torrent of "boiling-hot" water and mud rushing down the valley, and that a wall of water and mud fifty or more feet high (they compared it with the height of a factory chimney) came out of the upper reaches of the river and swept out to sea. There was no heavy rain that day before the eruption took place, but the lake still was in the crater early in the day, according to the tale of a fish-woman who had ascended the mountain from Georgetown that morning on her way home to Chateaubelair. The trail led along the rim of the crater for half a mile. The woman reached the rim at 9 o'clock and found that fissures had appeared in the ground, and that the lake was at a higher level than usual and boiling. She rushed back to Georgetown to warn the people, but her tale was discredited. Mr MacDonald's notes contain the entries: "12.55 p. m.—Enormous discharge to windward side; color, darker. 1 p. m.—Tremendous roaring; stones thrown out to windward thousands of feet."* While this does not *prove* the bodily out-throw of the lake, it shows that there was a great outburst from the crater just in advance of the flood in the Dry River Valley. The dust and lapilli thrown out by the volcano before this hour must have passed through the waters of the lake, as seemed to be happening on a small scale while we were looking into the crater May 31.

It is evident that there was a blast or a series of blasts of hurricane violence from the crater of La Soufrière as well as from that of Mont Pelée, as a feature of the eruptions of 1902. The effects were not so appalling, however, on St Vincent as on Martinique, because no large city was destroyed there. The overturned trees constitute the principal evidence on the island of St Vincent. They all point away from the crater, except for slight modifications due to local topography, and their roots are denuded of bark and show charring on the side nearest the crater, while the farther side preserves the bark uninjured. The trunks of the trees show the same condition — denuded and charred on the side nearest the crater, uninjured on the farther side. The villages of Wallibu and Richmond, on the leeward coast, were in much the same relation to La Soufrière that St Pierre was to Mont Pelée. Wallibu was carried down into the ocean by a landslide during the eruption of May 7, while Richmond was buried under from 5 to 20 feet of lapilli and dust.

The blasts extended radially in all directions from the crater, suggesting the explanation that great volumes of steam, rising from the throat of the volcano, could not find room for expansion upward, on account of the cushion formed by the column of steam and ashes which had preceded them, and the ashes falling therefrom, and that they expanded with explosive violence horizontally and downward, following the configuration of the mountain. This accords with the testimony of Mr MacDonald and other eyewitnesses of the eruptions who say that they saw the clouds of "smoke" (dust-laden steam) rushing down the sides of the mountain with terrific speed. This dust-laden steam was able to do much work of erosion, as is shown by the horizontally scoured sides of some of the exposed cliffs and by the trunks and roots of overturned trees. The roots particularly have been charred by the heat and carved into fantastic, pointed shapes, as if they had been subjected to the action of a powerful sandblast. The ordinary erosive action now is that the heavy rains take up vast quantities of the loose lapilli for use as a powerful scouring agent in attacking the denuded hillsides, and thus old valleys are being deepened and widened.

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*Century Magazine, vol. lxiv, p. 639, August, 1902.

The particular feature of the May eruptions of La Soufrière was the enormous amount of dust which was thrown into the air and distributed over a vast, somewhat elliptical area, the extent of which cannot yet be calculated for lack of data. The British steamship *Coya* had an eighth of an inch of volcanic dust from this volcano fall on her deck when she was 275 miles east-southeast of St Vincent. The steamer encountered the dust at 10.30 p. m., May 7, 8½ hours after the eruption of La Soufrière began, indicating transport against the prevailing surface wind at more than thirty-two knots per hour. Reports of vessels from the west (leeward) of the island have not come to my notice, but the statements of the islanders would indicate that the greater proportion of the cloud of dust went to the east and southeast. The dust was spread like a gray mantle over the island, generally diminishing in thickness from the crater outward, but collected in vast deposits in certain valleys on the sides of the mountain, where the conditions seem to have been particularly favorable. The chief of these beds were formed in the Wallibu, Trespé, and Rozeau valleys, on the leeward (west) side, and in the valleys of the Rabaka Dry River and its tributaries, on the windward (east) slope, with by far the greatest thickness along the Wallibu and Rabaka Dry rivers. In the valley of the Wallibu the deposits were not less than sixty feet deep in places, while in the Rabaka Dry River the fresh material filled a gorge which is said to have been two hundred feet deep before the eruptions began. From a distance this deposit looks as if it were a glacier coming out of the mountains.

The dust began to fall upon the Island of Barbados about 5 p. m., indicating the same rate of transport.

Several other reports quoted in the *West Indian Bulletin*, vol. iii, No. 3, p. 282, agree fairly well with this estimated rate of transport. One report reads: "May 8, bark *Jupiter* from Cape Town met dust at 2.30 a. m., 830 miles E. S. E. of Barbados," which would give a speed of 60 miles per hour. This great rate is so far in excess of what is indicated by the reports of the other ships that discredit is cast upon the report.

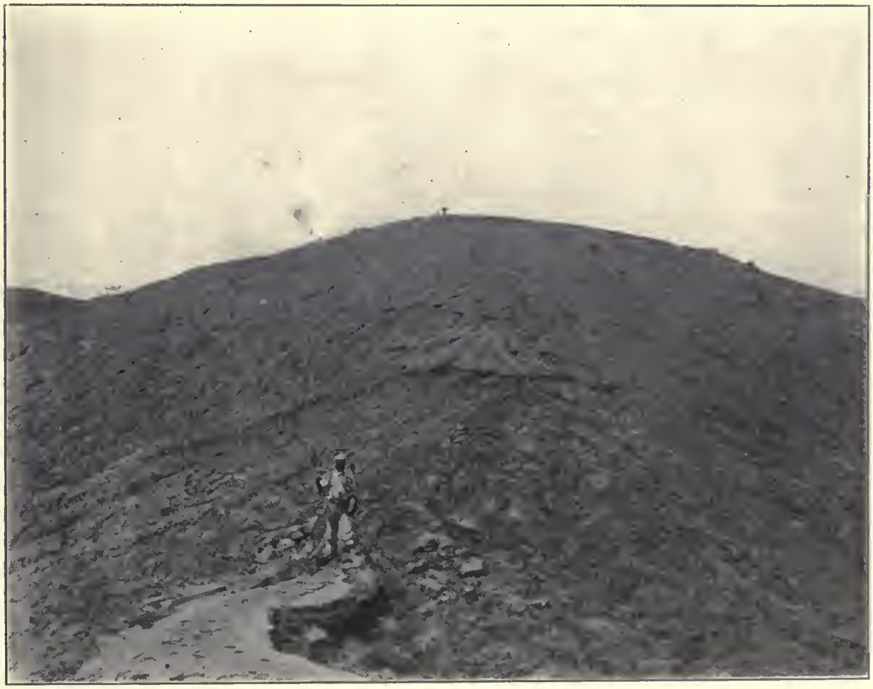
The following chemical analysis is of dust which I collected May 27 in a room in the Langley Park estate house, about one mile north of Georgetown, in which 21 dead bodies were found after the eruption of May 7. The analysis was made by Dr W. F. Hillebrand, of the United States Geological Survey, to whom my acknowledgments are due, and is the unpublished analysis referred to in his article in the July number of this Magazine (vol. xiii, p. 297) as emphasizing the greater amount of sulphur present in the ejecta of La Soufrière than in those of Mont Pelée. The absence of chlorine is interesting as indicating fresh waters as the probable source of the steam of the eruptions, in spite of the close proximity of the ocean:

SiO_2	55.08
Al_2O_3	18.00
Fe_2O_3	2.46*
FeO	4.57*
MgO	3.34
CaO	7.74
Na_2O	3.45
K_2O	0.65
H_2O at 100° C	0.66
H_2O above 100° C	1.39
TiO_2	0.80
ZrO_2	(?)
CO_2	None

*Only approximate, because of effect of pyrrhotite, 0.91 per cent. See below.

P_2O_5	0.17
SO_3	0.24
Cl	None, or faint trace
S	(0 36)*
NiO	None
MnO	0.21
BaO	Trace
SrO	None
Li_2O	Faint trace
Fe_7S_8 (?)	0.91
	99.67

The September eruptions, though more violent than those of May, deposited less fine dust on St Vincent, according to the newspaper reports and private letters received from Mr T. MacGregor MacDonald and Mr W. J. Durrant, druggist, of Kingstown. Samples of the material ejected by the outburst of September 3 have been received from both gentlemen. The material consists of fine and coarse, gritty volcanic sand and gravel, apparently for the most part comminuted ancient lavas of the volcano. The fragments from 3 to 15 millimeters across show the coarsely crystalline structure of the old lavas, and many of them show that they are parts of weathered masses. Olivine, pyrite (pyrrhotite?) and porphyritic crystals of feldspar, hypersthene, and hornblende are observable in these fragments. The separated minerals make up a large proportion of the particles about 2 millimeters across. A comparatively large fragment (20 mm. in diameter) shows phenocrysts of feldspar imbedded in dark-brown and light-brown scoriaceous volcanic glass which appar-



La Soufrière. Mud Coating Upper Portion of the Cone

From a photograph taken by Dr. E. O. Hovey, May 31, 1902, at an elevation of 1,500 feet above tide ently is fresh. All the particles are coated with dust, which seems to be as fine as any that fell during the May eruptions. Since the cloud from the September 3–4 eruption of La Soufrière is reported to have produced darkness for about six hours at Fort de France, Martinique, on September 4, it is probable that the fine dust of this eruption was thrown higher into the air than was that of the May eruptions, and was carried northward, away from St Vincent, before it settled.

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*Included in Fe_7S_8 (?).

Such great accumulations of hot lapilli and dust as those in the valleys of the Wallibu and Rabaka Dry rivers retain their heat for a long time, and they have given rise to secondary or superficial eruption phenomena of striking character and considerable interest. The river water and the water from the tropical showers percolating through the beds have come into contact with the still highly heated interior, causing violent outbursts of dust-laden steam. We saw one of these outbursts from the Wallibu Valley send up a column of such vapor fully a mile in height. The action lasted for nearly an hour, and followed directly after a heavy shower.

In the morning of May 30, which was clear and dry, we witnessed the throwing of a dam across the stream and the formation of a temporary lake by a heavy secondary outburst of dust-laden steam from the lapilli bed in the Wallibu Valley. This eruption must have been caused by percolating river water, since there had been no rain for at least eighteen hours when it occurred. After the eruption ceased the little lake soon rose to the top of the dam and quickly cut its way down to the old level, sending a "mud-flow" down the gorge to the sea. Such a lake in the valley of the Rabaka Dry River cut its new outlet through a narrow ridge of the old agglomerate constituting the wall of the canyon, forming as it did so a beautiful series of channel bowls, pot-holes, and scratched corkscrew channels.

When we first reached St Vincent the dust, especially that covering the Richmond estate, showed in marked manner the wind-drift surface so familiar in the case of freshly fallen snow, and in many places these drifts were from three to four feet deep. There were several heavy rains between May 24 and 29, so that the appearance of the surface was very different on May 30 from what it was when I first saw it. Its drifted character was not nearly as evident, and the beautiful dendritic drainage, which was already in evidence on May 24, had been greatly extended and intensified. Geological operations, which under ordinary conditions are so slowly performed as to be imperceptible, were being carried forward rapidly under our very eyes. One item of interest was the action of the Wallibu River itself as it cut into and undermined the beds of dust and lapilli along its banks. Its waters became so overloaded with sediment that they could only flow in pulsations, showing that intervals of time were needed by the stream to gather strength to force its way along with its burden. On May 24 these waves or pulsations were from fifteen to forty seconds apart.* Such mud streams carry large boulders down their beds and have great erosive power.

When the great cloud of ejecta rose from La Soufrière at 2 p. m., May 7, the portion which was traveling eastward seemed suddenly to split, according to the accounts of eyewitnesses, when it was some distance beyond the island, and to send a part back to the land. This is in accord with the fact that unprotected windows in the eastern side (that farthest from the crater) of houses in the devastated district along

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*This peculiar action of the Wallibu was first described by the author in a letter published in the *New York Times* of June 29, 1902.

the windward coast were all stripped of their glass, while immense quantities of dust were carried to the Island of Barbados, 90 miles due east, and beyond. The accounts of other eyewitnesses include the mention of a strong blast of volcanic material "returning from the sea" after the main cloud had rushed down the mountain. There probably was an inrush of air toward the mountain, due to the uprushing column from the crater acting on the east side in connection with the trade winds.

An official's estimate of the loss of life on St Vincent by the eruption places the number of killed at 1,350. The actual number of bodies buried was 1,298, including those of the wounded who died in the hospitals. Almost all of the people who passed through the fury of the eruption and escaped uninjured had taken refuge in cellars, the only openings into which were on the side farthest from the crater, and were, moreover, tightly closed with wooden doors or shutters. The most striking example of such protection was at Orange Hill, on the windward coast two and one-half miles north of Georgetown, where one hundred thirty-two persons were saved unharmed in an empty rum cellar. This cellar, which is only partly underground, is part of a sugar factory situated on a rather flat divide between two ravines, which may have tended to separate the volcanic storm somewhat, though the roof of the building over the cellar was demolished by the ejecta. The only openings into the cellar were a door and two windows on the side opposite the crater, and these were provided with heavy wooden shutters which were kept closed during the fury of the eruption.

The manager of the estate, Alexander McKenzie, with his wife and a son, remained in the manor house, scarcely a hundred yards from the rum cellar, and were killed during the eruption, apparently by asphyxiation. The house had large windows, the glass of which was shattered by the projectiles from the volcano, permitting free entry to the deadly dust-laden steam. These three Scotch people and a Portuguese employé at the Wallibu sugar works, on the leeward side, were the only white people killed by the eruption. The experiences of the people in the cellars suggest the great desirability of constructing similar places of refuge for use in time of hurricane as well as of volcanic eruption.

The deaths on St Vincent seem to have been due, principally, to the following causes: (1) asphyxiation by hot, dust-laden steam and air; (2) burns due to hot stones, lapilli, and dust; (3) blows by falling stones; (4) nervous shock; (5) burning by steam alone, and (6) strokes of lightning The last-mentioned cause is perhaps somewhat doubtful, for though it is very generally named by the survivors, there has been no substantiation mentioned beyond the fact that there was a great deal of extremely vivid lightning during the eruption. The action of steam would account for the burns received underneath the clothing where the clothing was not even charred. Sulphur dioxide, SO_2, and hydrogen sulphide, H_2S, were observed in troublesome quantities in the steam coming from the crater, and it is more than probable that these gases, especially the former, added very materially to the deadly character of the dust-laden steam. Strange as it may seem, not an autopsy was made on any of the hundreds of victims of the catastrophe, so that it never can be known definitely what part was played by these or other poisonous gases in the destruction of human life.

APPENDIX

The following additional notes regarding La Soufrière have been derived from private letters and other sources since the foregoing article was sent to the printer :

From a pamphlet by Mr Huggins, printed in St Vincent and entitled "An account of the eruptions of the St Vincent Soufrière," the following table (page 25) has been taken (see page 445 in this number) :

Table of Soundings in the Crater Lake of the Soufrière in St Vincent Taken by P. Foster Huggins During 1896 to 1900.

Date.	Distance from shore.	Point from which taken.	Depth.
Nov. 1896	4 feet	West	4 feet
	6 "	West	6 "
	8 "	West	23 "
	10 fathoms	West	25 fathoms
	20 "	West	35 "
	40 "	West	53 "
	60 "	West	83 "
	100 " (about)	West	
1900	12 feet	East	40 feet
	100 "	East	112 "
	60 "	East	150 "
	40 fathoms	East	47 fathoms
	60 "	East	
	100 " (about)	East	78 "
	Center	East	86¾ "
1898–'9	Close rocks	South	2½ "
	40 feet	South	6 "
	80 "	South	28½ "
	40 fathoms	South	52 "
	60 "	South	63¼ "
	80 "	South	74 "
	100 " (about)	South	81 "
	Center	South	87½ "
1900	20 fathoms	South	36 "
1896	4 feet from rock	North	5 "
	20 " " "	North	16 "
	60 " " "	North	43 "

From T. MacGregor MacDonald, Esq. : On Tuesday, August 19, three young men by the name of Richards (residents of Kingstown) ascended the mountain, and found the crater to be in apparently the same condition as we found it May 31. Mr MacDonald ascended a few days later, and found the same, except for greater volumes of steam rising.

Paul Chastenet (communicated by Mr MacDonald) states that at 9.25 p. m., August 30, "halos" appeared in atmosphere near Chateaubelair at the time when detonating noises (from Mont Pelée) were being heard in St Vincent. Two circular concentric bands of light came toward the town from La Soufrière. When near the town the bands expanded and separated into four concentric rings and faded away toward Chateaubelair Island. These would seem to be an electrical phenomenon.

Wednesday night and Thursday morning, September 3 and 4, occurred the eruption already referred to in the body of this article. The notch in the crater rim on the west side over Larakai Valley seemed to Mr MacDonald to have been enlarged by this eruption. On September 6, at 4 p. m., a column of dust-laden steam rose from the crater to an elevation of between five and ten thousand feet. On September 12 steam was rising vigorously from the western part of the crater, and during the afternoon of the 13th there were several lofty discharges, sometimes from the western side of the crater, sometimes from the eastern, and sometimes from the middle.

September 14, 8.25 p. m., vigorous and continuous escape of steam, five to ten thousand feet into air, from western side of crater ; mountain entirely free from atmospheric clouds.

September 17, Messrs J. Adams and W. Cummings ascended the mountain. They found the crater filled with lapilli to about the level of the old lake, as it existed before May 7. There was a sloping surface from all sides toward a depression in the middle. This slope could have been descended from almost any point of the rim. Steam was issuing from several openings, but most vigorously from the extreme east of the crater. Around the central opening there was "mud," and from the opening "fire" [incandescent stones ?] was being discharged to moderate heights at intervals of two or three minutes. Cummings stated to Mr MacDonald that the east-west diameter of the crater seemed to have been increased, and the saddle between the large and the small crater was more deeply notched than before.

At about 1 a. m., September 18, there was a comparatively slight eruption of La Soufrière. On the following day (the 19th) Mr Cummings, accompanied by Rev. Mr T. Huckaby, of Chateaubelair, again ascended to the rim of the crater. They found that the crater had been cleared of the ashes observed there on the 17th, and that it had been restored to the condition of May 31, with a small amount of water in the bottom of a vast pit.

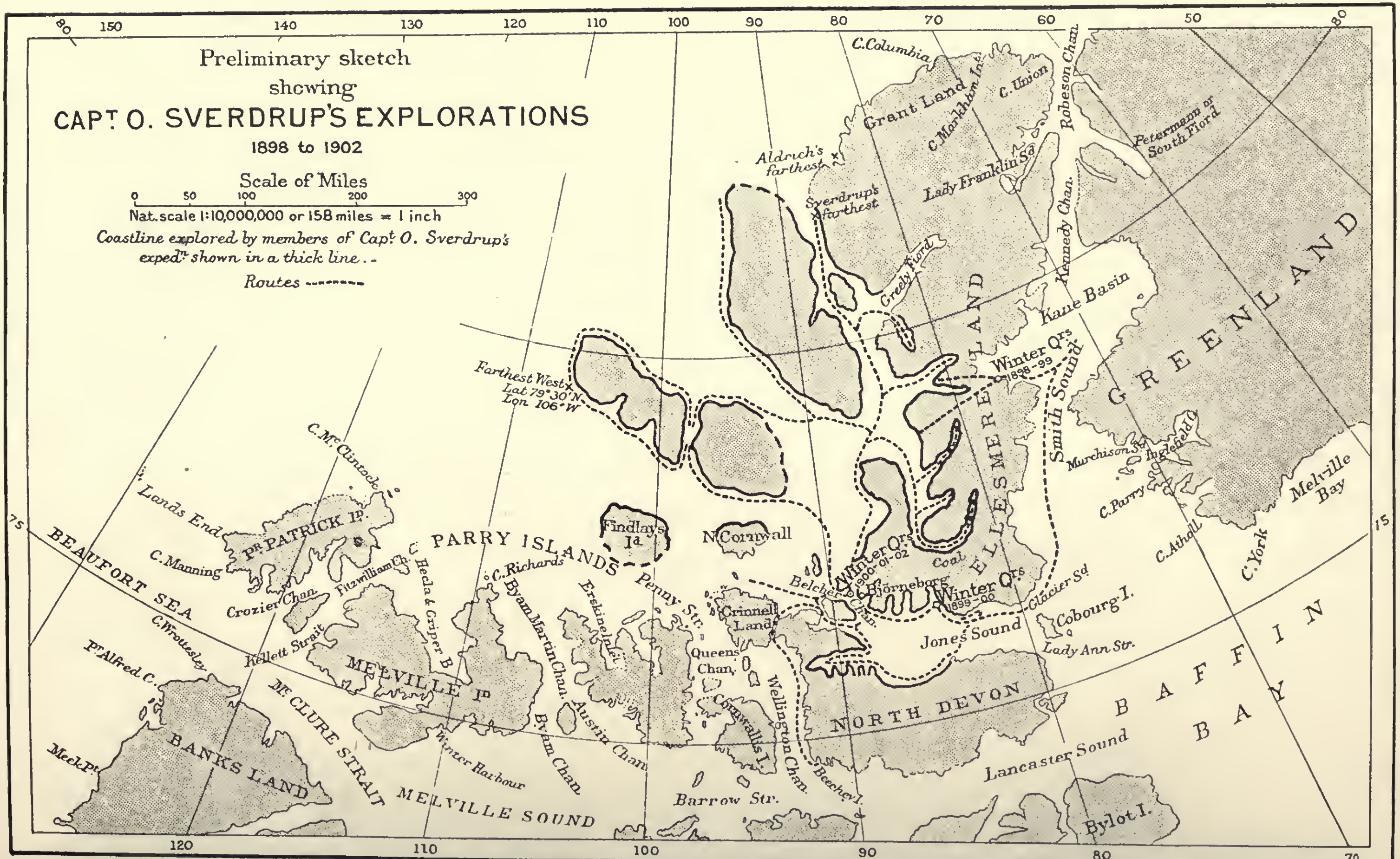
Sunday, September 21, at 6 p. m., there was a violent eruption, which lasted but ten minutes in its vigorous stages. Much incandescent material is reported to have been thrown out during this outburst, but this statement is doubted by Mr MacDonald on account of the red glow from the setting sun. The eruption seemed to come from the northwest side of the crater, and was accompanied by horizontally projected clouds.

On September 24 there was a sudden eruption at about 2.30 p. m., which lasted about half an hour. The solid matter thrown out in this outburst must have been coarse and heavy, for it all fell to the ground and sea in a short time and the horizon was perfectly clear by 3.30 o'clock.

Under date of October 24, Mr W. J. Durrant writes me, after mentioning the outbursts of September 18 and 21, that there was a slight eruption on October 1 at 6.35 p. m., and he then goes on to describe the great eruption of October 15, which he considers the most violent of the series. He states that the eruption began at 8.15 p. m. (the Kingstown *Times* reports the beginning to have been at 7.45 p. m.) and continued in violence till 9 o'clock, when there was a lull. The volcano burst again into full eruption at 1 o'clock the same night and continued in this condition till 5 a. m. The eruption was accompanied by tremendous roaring and a magnificent electric display like that of September 3-4. The sand-and-dust clouds went to windward, depositing much material at Georgetown and northward, while southward great damage was done in the Mesopotamia Valley, where 12 inches of ashes fell. After the great outburst the volcano continued in considerable activity, with minor eruptions, until October 22, when a moderately heavy eruption took place, which threw dust on Richmond estate and Chateaubelair. The encroachments of the sea upon the leeward coast of the mountain continue, especially at the mouth of the Wallibu River.

The Kingstown *Sentry* of October 31 contains an account of the ascent of La Soufrière made on October 28 by Mr Henry Powel, curator of the botanical station on St Vincent, in company with Messrs J. P. Quinton and E. W. Foster, visiting botanists, in spite of the continued activity of the crater. They ascended the mountain from the leeward side and found the journey very difficult on account of the erosion which has taken place since the early eruptions. They found the crater more funnel-shaped than had preceding visitors, but with boiling muddy water in the bottom. Hot ashes, which were steaming profusely, were piled several hundred feet high against the walls of the pit. Coarse gravel and fragments of rock covered the exterior slopes of the cone. The saddle between the two craters is still existent, and Mr Powel was satisfied that no eruption had come from the small crater. No stream of lava has been ejected yet. The rent in the crater on the western side has been enlarged.

At 8.15 p. m., October 29, a loud groan was heard from La Soufrière, followed by a column of dark vapor, and further eruptions were feared.



Preliminary sketch
showing
CAPT. O. SVERDRUP'S EXPLORATIONS
1898 to 1902

Scale of Miles

Nat. scale 1:10,000,000 or 158 miles = 1 inch

Coastline explored by members of Capt. O. Sverdrup's exped.ⁿ shown in a thick line. -

Routes --------

GEOGRAPHIC NOTES

SVERDRUP'S WORK IN THE ARCTICS, 1898-1902

THE map on the opposite page shows the routes followed and coastline explored by Captain Sverdrup in his four years of Arctic work. In the November number of the *Geographical Journal* Sir Clements R. Markham, President of the Royal Geographical Society, has summarized the work of Sverdrup and his gallant companions as follows:

"They have discovered the western side of Ellesmere Island and its intricate system of fiords, as well as three large islands west of Ellesmere Island; they have explored the northern coast of North Devon; they have connected Belcher's work with the coasts of Jones Sound; they have reached a point within 60 miles of Aldrich's furthest; and they have discovered that land north of the Parry Islands, the existence of which was conjectured, as far west as the longitude of the eastern coast of Melville Island. This includes the discovery of the northern sides of North Cornwall and Findlay Island. In addition to the main Arctic problem which is thus solved, it is likely that the region discovered will be of exceptional interest, from the winds and currents, the varying character of the ice, the existence of coal beds, and the abundance of animal life. A systematic survey has been made of these important discoveries, checked by astronomical observations. We must look forward to an account of these things, and to the details of the expedition, with the deepest interest; and meanwhile we may well express admiration for the way in which the work was conceived and executed, and at the perfect harmony with which all loyally worked under their chief. Without such harmonious work success was not possible."

VOLCANIC DISTURBANCES IN GUATEMALA

REPORTS from Guatemala tell of devastation and death by the recent eruptions of Santa Maria as horrible as the tragedies of St Pierre and St Vincent. Santa Maria is a volcano in western Guatemala, about 50 miles from the Pacific coast. It began to erupt October 25 and continued more or less active until November 9.

"The country for a radius of over 30 miles has been made a desolate waste, and every vestige of life destroyed. The loss of life is estimated at over 7,000, the great majority of the victims being Indians. Ten Indian villages, each with a population of from 50 to 5,000 inhabitants, were wiped out, the rude huts being buried beneath tons of volcanic débris. All of the coffee plantations in the volcanic zone are ruined, and their owners left penniless. The greatest distress prevails throughout the central and western portions of the republic, and even on the eastern coast the effects are felt in the scarcity of money and the rise in exchange.

"A famine prevails at Quezaltenango, and 10,000 people are starving. Even in Guatemala City, the capital, the inhabitants are suffering for food. The government is utterly unable to relieve the distress and suffering, and the people are on the verge of revolution. The only thing needed to start a formidable uprising is the appearance of a leader."

Porfirio Herrera, who owned a valuable coffee plantation seven miles from the volcano, gives the following account of the eruption:

"The eruption ceased on the morning of November 9, when I ventured to my plantation and found it buried beneath ten feet of ashes, mud, and sand hurled from the volcano. Everything on the place was in ruins.

"My residence was destroyed, and out of 112 laborers employed on the plantation all but seven perished. The seven who escaped happened to be visiting a farm eight miles farther from the volcano that day, and when they saw the danger took refuge with a lot of others in a cave. My family was in Guatemala City, and therefore escaped.

"On the trip to my plantation I passed a number of other large coffee plantations which had shared the same fate as my own. The scene along the route was frightful. The dead bodies of Indians and animals, who had been suffocated by the deadly fumes, were visible everywhere, and the stench was awful. I passed through one Indian village where over 350 had perished. All of the bodies had their hands to their nostrils, showing plainly what caused death. The damage to the country is beyond repair.

"Two new craters had been formed in the mountain side, and were in eruption at last accounts."

EXPLORATIONS AROUND MOUNT McKINLEY

THE Brooks Alaskan expedition of 1902 fulfilled in the main the program of work in the Mount McKinley region outlined by Mr Brooks in the April number of this Magazine, p. 134. Eight hundred miles were traversed, probably the longest journey with a pack train ever made in Alaska. An instrumental survey was made throughout by Mr Raeburn and his observations made to connect with his surveys in 1901 beyond the Yukon. Thus in the two years' work a belt has been surveyed from Cook Inlet to the Arctic Ocean, a distance of 2,000 miles, and a record for reconnaissance work in Alaska. Evidences of glaciation were found everywhere from Cook Inlet to Tanana up to altitudes of 4,000 or 5,000 feet. Dr Brooks reports the Mount McKinley region probably the best game country in the world. Deer, caribou, bear, and birds were constantly in sight, and so tame that they could knock them with a stick. As elsewhere in Alaska, the mosquitoes incessantly attacked them in clouds, except for four or five hours at night time, from 10 to 3, when the party obtained some rest.

The remarkable magnetic disturbance which attended the eruption of Mont Pelée on May 8, 1902, and which was noted in the June, 1902, number of this magazine, page 208, was recorded at practically all the magnetic observatories throughout the world. This extended magnetic disturbance is something entirely new in our history of volcanic action, as no magnetic disturbance has previously been noted and recorded as attending a volcanic outburst. The data and observations recorded in May, 1902, at the various magnetic stations in the world have been collected by the Magnetic Division of the U. S. Coast and Geodetic Survey. A study of these observations is now being made by the Survey under the direction of Dr L. A. Bauer, and in due time an announcement of the results will be made.

Dr Walter Reed, who freed Cuba of yellow fever, which had scourged the island for centuries, died at his home, in Washington, D. C., November 23, 1902. By his discovery that the yellow-fever germ is carried by mosquitoes, he has made the northern tropics habitable in a true sense. The importance of his discovery is considered second only to Jenner's discovery of vaccination. Dr Reed had only reached his fifty-second year, but he had the satisfaction of knowing that, as a result of his study and efforts, not a single case of yellow fever had occurred in Habana during the last year of his life.

Dr David T. Day, Chief of the Division of Mineral Resources of the U. S. Geological Survey, has been elected a member of the Board of Managers of the National Geographic Society to fill the unexpired term of Mr Henry Gannett. As Mr Gannett will remain in the Philippines for a year or more, engaged in the census of the islands, he has resigned temporarily from the Board. Dr Day was a member of the Board 1896–1899.

In November, 1902, the remains of Christopher Columbus were buried with great pomp for the fifth time. Their last and, it is hoped, permanent resting place is a special mausoleum in the grand Cathedral of Seville. From Valladolid to Seville, from Seville to Hispaniola, from Hispaniola to Habana, and from Habana to Seville again, is the strange story of the journeying of Columbus' remains.

GEOGRAPHIC LITERATURE

Father Marquette. By Reuben G. Thwaites. Illustrated. Pp. 244. New York: D. Appleton & Co. 1902. $1.00 *net.*

The work of Father Marquette as an explorer of the Mississippi, as a preacher, and a friend of the Indians won for him a prominent and lasting place in the hearts and imagination of the American people. His name stands for what has been best and noblest in the history of white men's dealings with the Indian. This biography by Dr Thwaites is especially welcome, inasmuch as, except for brief biographies of Father Marquette by Sparks and Shea, no other has been published. The volume consists mainly of an account of the long canoe voyage (1673) of Marquette and Joliet from Lake Michigan to Portage on the Wisconsin River, thence down the Wisconsin to the Mississippi, which they descended to the mouth of the Arkansas, and then back again up the Mississippi to the mouth of the Illinois, and up the latter and the Chicago to the west shore of Lake Michigan, a journey of over 2,500 miles. By this voyage the explorers proved that the great river of the west flowed to the Gulf of Mexico and not to the Pacific or to the southeastward through Virginia. Marquette was so weakened by the fearful hardship of the four months' canoeing that he died in 1675, at the early age of 38 and after only nine years of service in America. Joliet lost his narrative and maps of the exploration, but the journal and maps of Marquette were preserved long enough for a copy to be made of them, and this is the only record we have of one of the most remarkable explorations in American history.

The Land of Nome. By Louis McKee. Pp. 260. New York: The Grafton Press. 1902.

Mr. McKee gives a vivid picture of the blindness of the stampede to Nome of 18,000 fortune-hunters in the summer of 1900. The past neglect, the present needs, and the untold resources of our wonderful Alaska are described. To quote from the author:

"Uncle Sam's record in Alaska has not been one to be proud of. A taxed, unrepresented people, who, under the greatest adversities, have shown to the world the enormous and varied resources of a supposedly barren land, have for years had to bear the additional burden of incompetent and unscrupulous officials who have been foisted upon the country. The rush to Cape Nome has attracted attention to only a comparatively insignificant portion of Alaska, and emphasized but one of the treasures in its vast, unexplored storehouse.

"In the north and east, and over by the Canadian border-line, is the world-famous Klondike region. Fifteen hundred miles distant to the west, close to Siberia, are the Nome gold-fields. Southeast are found seemingly inexhaustible quartz-gold mines, the greatest salmon fisheries in the world, and a climate and soil which will make agriculture possible and profitable. And away to the south and west are immense forests, mines of copper, and the Pribilof Islands, the home of the fur-seal. Within the boundaries of Alaska there lies a country incomprehensible in its extent and difficulties, inconceivable in the possibilities of its latent wealth. The marvelous discoveries of gold at Cape Nome, which have entailed so much hardship and scandal, bringing riches to many and disappointment to more, will at least have worked a highly beneficent result in bringing earlier to light the neglect and needs of our wonderful Alaska."

Journey to Lhasa and Central Tibet. By Sarat Chandra Das. Edited by W. W. Rockhill. Illustrated. Pp. 285. London: John Murray. 1902.

The author of this volume was born of a Hindu family of the medical caste in Eastern Bengal, in 1849. In 1879 he entered Tibet and remained for six months at Tashilhunpo, a great center of lamaist learning, as the special guest of the Prime Minister. He had previously thoroughly mastered the Tibetan language, and was thus equipped to gain the most from this opportunity for research. In November, 1881, Sarat Chandra started on his second journey to Tibet, and this time succeeded in making a short visit to Lhasa and extended explorations along the Tsangpo. On his return to India in 1883 he began editing and publishing in English text some of the 200 manuscripts and volumes he had brought back with him. The present volume is a narrative of his second expedition to Tibet. The illustrations in the volume are very clear and give a good idea of the people and country. Two photographs of Lhasa are specially noteworthy—one a general view of the mysterious city and one showing the imposing palace of the Grand Lama.

Prisoners of Russia. By Benjamin Howard. Illustrated. Pp. 389. New York: D. Appleton & Co. 1902.

In 1891 Dr Howard passed several weeks in Sakhalin, the island on the northeastern coast of Asiatic Russia where Russia sends her most dangerous criminals and such politicals as are considered equally dangerous. Dr Howard died before this volume of his observations was published, and in his stead Gen. O. O. Howard, a personal friend of the author, contributed the preface. Sakhalin is as long as England, about 650 miles, but her width is less, ranging from 50 to 150 miles. There were about 12,000 convicts on the island at the time of Dr Howard's visit. Several chapters are devoted to describing the island, the life of the convicts, their work, punishments, etc., and then several chapters to a discussion of the relative merits of the Siberian and Anglo-American penal systems. Dr Howard concludes the comparison as follows: "In America and England, but perhaps in England more especially, the administration is remarkably good, the principles outrageously inhuman and bad. In the Siberian system the administration has rarely been good and frequently has been outrageously bad, but, as regards the general principles of the Siberian system, they are in accordance with the constitution of man, of laws, both natural and revealed, and are therefore exceedingly good." Dr Howard was the author of the "Direct System of

Artificial Respiration" which is generally used throughout the world for resuscitating persons seemingly drowned.

The East of Today and Tomorrow. By Bishop Henry C. Potter. New York: The Century Co. 1902. $1.00 *net*.

In this little volume Bishop Potter presents some of his impressions of the Far East, which he visited after the Boxer uprising had been crushed, He believes that China is at last awakening from her torpor, and, recognizing her deficiencies, is reaching out to Japan for help and guidance in correcting them. Bishop Potter's broad and humane view of the Chinaman is the best feature of a book which in other respects contains very little that is new. The Chinaman speaks extravagantly; the westerner speaks directly. Because the westerner does not find the words of the Chinaman fulfilled literally is no reason, says Bishop Potter, for calling all Chinamen liars.

Report of the Smithsonian Institution for the year ending June 30, 1901. Illustrated. Pp. 782. Washington: Government Printing Office. 1902.

The first part of this annual includes the proceedings of the Board of Regents, the report of the Executive Committee of the Board, and the administrative reports of the Secretary and of the heads of the scientific bureaus under the Smithsonian. The great bulk of the volume, practically four-fifths, is devoted to the general appendix, in which are presented a series of popularly written articles summarizing scientific progress in various lines during the year. Among the articles of a geographic interest may be mentioned: "Forest Destruction," by Gifford Pinchot and C. Hart Merriam, who emphasize the almost certain annihilation of the fauna and flora which follows the disappearance of the forest; "The Abbott Collection from the Andaman Islands," by Lieut W. E. Safford, an interesting description of an island people who from earliest times have been considered one of the most savage races in existence and whom Dr Abbott declared the "very blackest people I have ever seen;" "Irrigation," by F. H. Newell; "A Fire Walk Ceremony in Tahiti," by S. P. Langley (portions of this paper appeared in the NATIONAL GEOGRAPHIC MAGAZINE of December, 1901); "The Wanderings of the Water Buffalo;" "The Dinosaurs or Terrible Lizards," by F. A. Lucas, and "Bogoslof Volcanoes," by C. Hart Merriam. Some of the papers are reprints, while others were written specially for the report.

Annals of Switzerland. By Julia M. Colton. Illustrated. Pp. 301. New York: A. S. Barnes & Co. 1897. Republished 1902.

The author aims to present a "brief consecutive narrative of the struggles, progress, and attainments of a race of freemen." Miss Colton pays proper deference to the traditions which "belong as truly to the land as do its glaciers and avalanches," and which in the telling have stirred and ennobled the ambitions of generations on generations of the people.

Forestry in Minnesota. By Samuel B. Green. Illustrated. Pp. 401. Published by the Geological and Natural History Survey of Minnesota. 1902. 37c. postpaid.

This volume is a second and enlarged edition of an admirable work first published in 1898. It has been used with success as a text-book in many agricultural colleges and normal schools in the United States. The first half of the book Dr Green devotes to "Elementary Forestry," including chapters on "Tree Planting," "Nursery Practice," "Forest Protection," "Wood and its Uses," and "Forest Economics." The second half is a description of the "Trees of Minnesota," concluding with a list of the forest trees of the United States.

PROCEEDINGS OF THE NATIONAL GEOGRAPHIC SOCIETY

ANNOUNCEMENTS

REGULAR MEETINGS:

December 5.—"The Work of the Weather Bureau." Dr Willis L. Moore.

December 19.—"The Work of the Signal Office, War Department." Gen. A. W. Greely.

January 2.—Annual meeting. Reports and elections.

January 16.—"The Work of the Hydrographic Office, Navy Department." Commander W. H. H. Southerland.

January 30.—"The Work of the Office of Experiment Stations, Agricultural Department." Dr A. C True.

February 13.—"The Work of the Census Office." Hon. William R. Merriam.

February 27.—"The Work of the Naval Observatory." Capt. Charles H. Davis.

March 13.—"The Work of the Geological Survey." Hon. Charles D. Walcott.

March 27.—"The Work of the Library of Congress." Hon. Herbert Putnam.

POPULAR LECTURES:

December 12.—"Argentina—Present and Future." E, L. Corthell, C. E. (Illustrated.)

January 9.—"The Turk and His Rebellious Subjects." Mr William E. Curtis. (Illustrated.)

January 23.—"The Tragedy of St Pierre." Mr George Kennan. (Illustrated.)

Provisional arrangements have also been made for lectures on Colombia and the Isthmian Canal; America Before the Advent of Man; The Geographic Distribution of Insanity in the United States; Russia of Today (by Paul du Chaillu), and a lecture by Mr John Muir.

The Lenten Course of five lectures will be delivered in Columbia Theater, F street, near Twelfth, at 4.20 o'clock, on Wednesday afternoons of February 11, 18, 25, and March 4, 11.

The subject of this course and the speakers assigned for the special topics will be announced in a later program.

November 7, 1902.—The first regular meeting of the Society for the year 1902–1903 was held in the Assembly Hall of the Cosmos Club at 8 o'clock p. m., Acting President W J McGee, LL. D., in the chair. Hon. William F. Willoughby, Treasurer of Porto Rico, delivered an address on "Some of the Administrative and Industrial Problems of Porto Rico." An abstract of the address follows:

In assuming the responsibility of the government of Porto Rico the American authorities found themselves confronted with two distinct but yet related tasks: (1) To endow the newly acquired possession with political institutions and systems of law at once conforming to American ideals of individual liberty and political justice and yet adapted to the peculiar local conditions existing and the character of the inhabitants, and (2) to bring about a development of the industrial resources of the island.

The general policy of the United States has been (1) to administer the island solely with a view to its own interest, and in no way as a source of revenue to the federal treasury, and (2) to endow the island with the largest measure of local self-government that it is fitted to enjoy.

In carrying out the first part of this policy not the slightest effort has been made by the United States to recoup itself for expenditures incurred during the war resulting in the annexation of the dependencies nor the expense subsequently incurred for their administration and development while under military government; but it has been provided that in the future, or for an indefinite time to come, all receipts in the way of customs duties or excise taxes collected in the island shall be turned into the insular treasury instead of the federal treasury. In consequence of this provision, the island enjoys an enormous advantage over what it would have were it a state or organized territory of the Union. Over two-thirds of the revenue of the island of Porto Rico is obtained from these two sources of excise taxes and customs duties, which in the United States would be covered into the general treasury. While thus foregoing the receipt of any revenue from the island, the United States not only exercises a general care of Porto Rican interests in the way of military and naval protection, but performs at its own expense such industrial and commercial services as the maintenance of light-houses and harbor buoys, a marine hospital service, a weather bureau, etc., and has also recently established an agricultural experiment station on the island, and contemplates conducting very important experiments and investigations for the development of the agricultural resources.

The execution of the second feature of the policy can be only gradually accomplished. It may be said to comprehend three phases: (1) The immediate endowment of the island with the maximum measure of self-government that the educational and moral attainment of its inhabitants and the training that they have had in the management of public affairs qualify it to enjoy; (2) the administration of affairs in the dependency with the distinct aim in view of educating the population in a knowledge of the true principles and order of political action and the cultivation of habits of political morality, and (3) the actual extension of the local or self-government that was first granted to the dependency as rapidly as success is attained in these educational efforts.

From the foregoing it will be seen that in the management of its dependencies the United States has to deal with what is a dual problem—that of government proper and that of the education in the knowledge and principles of government of the people governed. This duality of the task should never be lost sight of in any study of the problem or in an attempt to judge of the success achieved in its solution. The work to be done is rendered enormously more complicated and difficult in consequence of the adoption of this second aim.

The first step for the organization of a permanent civil government for the island was taken by Congress through the passage of the "Foraker act," approved April 12, 1900. This act provided for the organization of a civil government, to take effect May 1, 1900. It attempts to do nothing further than provide a bare outline of government. It specifies that the government of the island shall be vested in certain bodies and offices, and outlines their respective fields of authority. Here it stops. All the details of the organization of an actual administrative machinery and the determination of the methods of work are left to the subsequent actions of the government thus created.

The government of the island is vested in an executive consisting of a governor and six heads of administrative departments—the secretary, attorney general, treasurer, auditor, a commissioner of the interior, and commissioner of education—and in a legislature composed of two houses—an executive council, or upper house, and a house of delegates, or lower house. The governor and the six heads of departments are appointed by the President. To the legislative assembly of two houses, known as the house of delegates and the executive council, is given full power to legislate regarding all matters relating to Porto Rico, subject only to the provisions of the organic act and to the laws enacted by the Congress of the United States.

The sessions of the legislature are limited to 60 days each year, beginning with January 1, though extra sessions may be called in the discretion of the governor. All bills may originate in either house, but no bill can become a law unless it receives a majority vote of all the members belonging to each house, and is afterwards approved by the governor within ten days after its passage. The governor has the usual power of veto.

The house of delegates constitutes the popular branch of the legislature. It is through this body that the people of Porto Rico exercise a real voice in the administration of affairs. It is composed of 35 members, elected annually by the qualified voters of the island. The determination of the right of franchise was left by the organic act to the insular legislature. In pursuance of this power a comprehensive election law has been enacted, patterned after the system in force in the United States, which in turn is that known as the Australian or secret ballot system. By the law the franchise is given to every male citizen of Porto Rico or of the United States of the age of 21 years and upwards who shall have resided in Porto Rico for one year preceding the date of election, and for the last six months within the municipal district where the vote is cast, who possesses any one of the three following requirements:

(1) Able to read and write.
(2) Owns real estate.
(3) Pays taxes.

At the elections, which are held on the same day as the elections in the United States, the voters vote for delegate to Washington, members of the house of delegates, and municipal officials.

The disorders that occasionally take place during the heated campaign preceding the elections are without significance. While indicative of a certain lack of self-restraint, they are in no way indicative of the inability of the islanders to work under an election system. It is difficult to persuade the voters that all will be given a fair show, but as soon as this fact is established the violence will become less and less.

The executive council is the center or key to the government. The eleven members which constitute it are appointed by the President. Six of the members are also heads of the administrative departments, and in practice have heretofore been Americans. The other five members have in practice been native inhabitants of Porto Rico. The executive council has equal legislative powers with the lower house and may initiate legislation. As no legislation may be passed without the assent of both legislative bodies, the majority of the council, the six heads of the departments, in a certain sense can control legislation, but on the other hand they cannot secure legislation without the consent of the lower house. As a consequence any measure to become a law must meet with the approval of the representatives, both of the United States and Porto Rico. Hence the mutual recognition of the rights and desires of the two houses is necessary in order that the governmental machine can be made to work.

No greater mistake can be made than to suppose that the Porto Ricans are not able to exercise a positive voice in the determination of the laws under which they are to live or in the manner in which revenue shall be raised and expenditures made.

Two sessions of the legislature have now been held and a general scheme of local government throughout the island enacted. Some of the defects of the Spanish system were: innumerable districts or municipalities, a concentration of legislative and executive functions in the same hands, an innumerable number of offices, and as a result the expenditure of local funds for salaries, leaving no money for schools or roads, and the raising of revenue in such a way that the taxes were paid by the poor. All this has now been changed.

The number of municipal districts has been greatly decreased. A uniform system of keeping accounts for all the local governments has been put in force. The treasurer of the island has general direction over the finances of the district, and in case a district is not meeting its obligations can step in and assume control somewhat in the manner of a receiver of a corporation. The number of offices has been reduced and a law passed compelling the districts to devote a certain proportion of revenue to the schools and roads. The system of raising revenue has been entirely reorganized, and the revenue is now obtained from three main sources : (1) excise and license taxes on the manufacture and sale of rum, spirits, tobacco, etc , (2) a general property tax upon all real and personal property, with certain exemptions, and (3) a tax upon inheritances.

The revenue of Porto Rico is now from two and a quarter to two and a half million dollars per year, which is sufficient to meet all the expenses. At the end of the last fiscal year there was a balance of $230,000. The schools are now increasing in number, as the insular government devotes a certain percentage of its revenue to educational purposes, and this sum, taken in connection with what the municipalities have to provide by law, is sufficient to meet the requirements. The large amount of money devoted to the building of roads is resulting in an improved and definite system of highways.

In its industries Porto Rico is advancing favorably. The sugar and cattle industries are very flourishing ; but the coffee industry is in a very bad condition, as the European market was lost when the island came under American sovereignty. The telegraph system belongs to the government. There is but one railway, now financed by American capital, but railroad building is progressing, and before long there will be a line from San Juan to Ponce around the west coast. An automobile service is in operation from Ponce to San Juan, running across the island.

At the conclusion of Mr Willoughby's interesting address, Acting President McGee called for remarks.

Dr David T. Day inquired as to the extent the English language was being introduced into the schools of Porto Rico. Mr Willoughby replied that English was being taught in every school on the island. The children were quick to learn it, as they liked it, and also because they were ambitious to obtain employment by the government or the large commercial establishments, where the ability to read and write English was often essential.

Mr O. H. Tittmann asked what were the relations of the Porto Rican delegate to our government. Mr Willoughby stated that the Porto Rican delegate to the United States Congress had the full powers of the territorial delegates.

Mr Tittmann asked if any attempt was being made to raise oranges and citrous fruits on the island. Mr Willoughby replied that attempts were being made, but that they were as yet in the experimental stage. There was no doubt, however, that the island is adapted to the cultivation of such fruits. The question was one of management, as to whether the efforts would be remunerative.

Mr Tittmann inquired whether the island of Culebra belonged to Porto Rico. Mr Willoughby replied that it did.

Mr Tittmann said that he wished to call attention to the fact that the United States had not only maintained the lights and buoys placed along the Porto Rican coast by the Spaniards, but had also placed additional lights, and through the U. S. Coast and Geodetic Survey had made a complete survey of the coast and the surrounding islands, and had charted most of the harbors in the island.

Mr Willoughby said he wished to emphasize the value to Porto Rico of the survey of the coast and harbors. A triangulation of the island and a careful survey were most necessary before the question of land titles and boundaries, which were now much involved, could be settled, and the work that had been done was an excellent beginning.

Mr R. L. O'Brien inquired why it was that Porto Rico received the custom duties and excise taxes collected on the island, while in other territories in the United States the revenue from these sources was turned over to the federal government. Mr Willoughby replied that it was impossible to raise sufficient funds from the island to develop and build up the country. Unless the revenue from excise taxes and custom duties was turned over to the insular government, there would be no funds available for the improvement of the island by schools and roads.

Mr H. M. Wilson directed attention to the fact that the interior of Porto Rico had no roads. The agricultural resources of the interior were not opened because pony paths and trails were the only means of communication with the commercial centers. He would like to know what was being done for the development of a highway system. Mr Willoughby replied that road-building was going on in ten or fifteen sections of the island. Each road was part of a general plan to open up industrial centers and to make a system of thoroughfares that would be most serviceable. The insular government expected much from the law which compelled municipalities to devote a certain percentage of their taxes to the improvement of the highways, especially as this money was expended under the general supervision of the insular authorities

Mr Amos W. Hart inquired as to the general danger in Porto Rico from hurricanes and tornadoes. Mr Willoughby replied that the danger was slight. The hurricane of 1899 was exceptional. There had been nothing like it in hundreds of years.

Mr Hart inquired as to the general direction of the trade winds. Mr Willoughby replied that his impression was that the trade winds were from the northeast. The trade winds made the climate comfortable at all seasons of the year.

Mr Theodore L. Cole wished to know how the experiment of intrusting legislative power to the executive heads of the departments was working. Mr Willoughby replied that the experiment was working admirably, as thus the executive heads had the opportunity of introducing and explaining measures which they thought of importance to their department.

Mr Richard U. Goode inquired as to what was the extent of the public lands and the nature of land tenure in the island.

Acting President McGee stated that before Mr Goode's question was answered he would like to direct attention to a very interesting fact about Porto Rico, namely, that the land-tenure system in Porto Rico had come up in slow and steady development from the aboriginals, who had no individual ownership. We have in Porto Rico an epitome in four centuries of the development of land tenure, a development which took two millenniums in Europe. He was especially glad this question was raised, and hoped Mr Willoughby would answer it in full.

Mr Willoughby replied that when the United States Government took charge of Porto Rico there was doubt as to whether the public lands went to the insular or federal government. This doubt had considerably retarded the development of the island, as there were considerable public lands waiting development near the cities. The extent of the public lands would not be known until an adequate survey was made. The last Congress passed a law stating that all public lands that the President does not select for military or naval purposes shall be turned over to the insular government. As to land tenure, private property was held there as in the United States, except that it was unusual to have land conveyed by deed. Land had been conveyed chiefly by descent, the result being that titles and boundaries were very much involved. A survey of the island, followed by a land-registration system something like the Torrens system, was much needed. Conveying of land was now very expensive.

Mr Theodore L. Cole inquired as to the difference between the political parties. Mr Willoughby replied that there were two parties, the Federals and the Republicans, both of whom accepted unhesitatingly American sovereignty and only differed as to the extent of authority to be left to the United States Government. The Federals wanted the Executive Council, which is now an appointive office by the President, made elective, thus taking it out of the hands of the American authorities. The insular government does not approve of such a course, as Porto Rico has not yet developed a sufficient sense of political toleration. The Republicans in general are satisfied with the existing system, though holding that in time the management of affairs should more largely be intrusted to natives of Porto Rico.

Mr Richard U. Goode asked whether the spelling of Porto Rico as *Porto Rico* (without the u) was generally accepted. Mr Willoughby said he could not answer definitely. The Americans all use the abbreviated form, but the people probably do not.

Mr J. T. Granger asked what was the opportunity in the island for the investment of money as loans. Mr Willoughby replied that though the general rate of interest was 9 per cent., only a limited amount of money could be safely placed in that way. Almost the only security the people could offer is land. As the matter of straightening out titles and boundaries proceeds the opportunity for loaning money will increase. The best openings for capital are in the undertaking of direct-production enterprises

Mr Granger asked if there were any national banks on the island. Mr Willoughby replied that one had just recently been organized.

Dr A. C. True stated that the U. S. Department of Agriculture was actively at work in several directions. The Bureau of Land Industry had collected much valuable information about the plants of Porto Rico The Bureau of Soils had made a survey of a strip of land stretching across the island. The Bureau of Forestry had also made considerable investigations. A permanent experiment station had been established. The experiment station had received aid from the insular government, with which 200 acres of land for the headquarters had been purchased at Mayaguez. The experiment work at this station would be pushed as rapidly as possible. Mr Willoughby said the island was greatly delighted at the work of the Department of Agriculture and was expecting many valuable returns from the work.

Mr H. S. Williams directed attention to the fact that the Weather Bureau maintained an efficient climate and crop service in Porto Rico, which was investigating the influence of the climate on the crops there

Mr Granger inquired as to the ranching facilities on the island. Mr Willoughby replied that this industry was very flourishing, though it had to compete somewhat with the sugar industry, as the land which is suitable for ranches is also adapted for cane. Cuba was sending to Porto Rico for many cattle, which fatten on the native Porto Rican grass without being fed on grain. The Porto Rican oxen make splendid draft animals. The cattle industry is very flourishing, and will continue so.

Mr Henry Farquhar inquired whether the Porto Rican cattle made good beef. Mr Willoughby replied that they made such very good beef that there was a considerable demand for the exportation of the cattle for meat.

Mr Farquhar wished to know if the island was not too densely populated for cattle-raising, as the density of the population was over 200 per square mile. Mr Willoughby said that he did not think so; that the density of population in Porto Rico does not impress one.

Mr Granger asked what was the estimated value of good cane land. Mr Willoughby replied that good cane lands brought from $100 to $150 an acre, and that the best land cost more than that, the price depending on irrigation.

Acting President McGee, in conclusion, stated that all present greatly appreciated Mr Willoughby's address and the supplementary information he had given in answer to questions. All present were to be congratulated on obtaining this clear and most instructive picture of our new island.

G. H. G.

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